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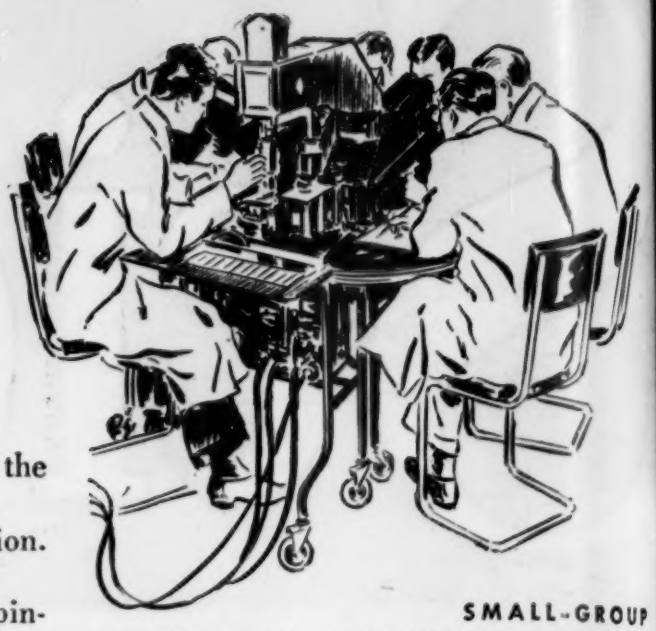

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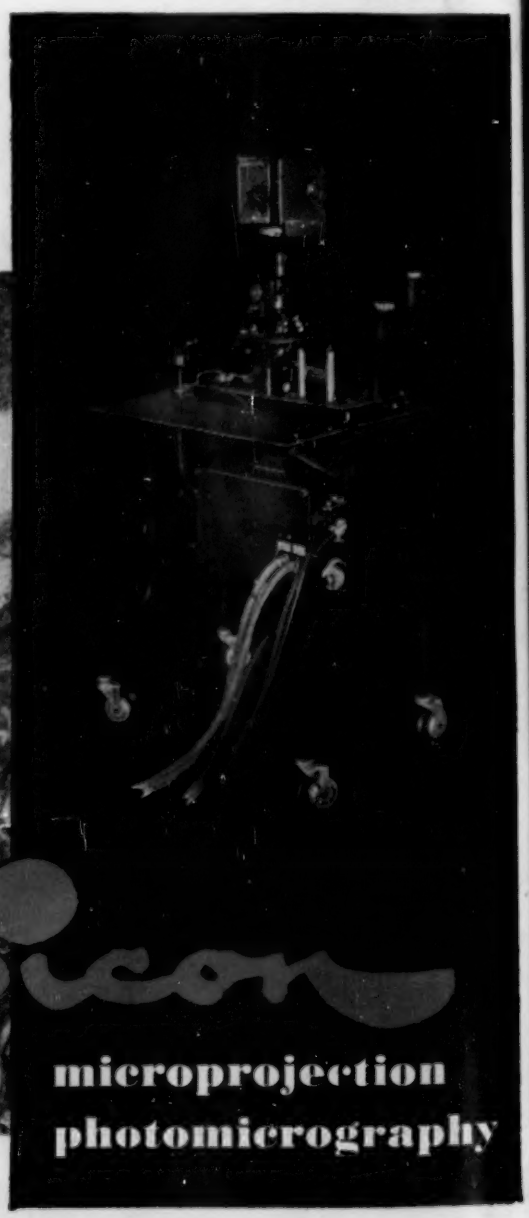

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Charting the Sea of Brain Waves

Herbert H. Jasper

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WE OF THE AMERICAN ELECTROENCEPHALOGRAPHIC SOCIETY have been brought together, first, by our principal common interest, the electrical activity of the brain. With this as a starting point, we find ourselves led into many related fields concerned with brain function, its anatomy, its metabolism, its circulation, its biophysical properties, and, above all, its functional characteristics, which underlie human thought, experience, and action. We are also led into studies involving the application of electrical recording techniques to other parts of the neuromuscular system, and even the bioelectric properties of the skin have not been neglected by certain members of our Society.

With the development of new and improved techniques by our colleagues, the electronics engineers, the biophysicists, the physical chemists, and the more pure electrophysiologists, the scope of interest of the members of this Society is an ever-broadening one. Our first and foremost interest is—and I hope shall always be—scientific investigation into the basic mechanisms and fundamental properties of nervous system function, with special emphasis on neuronal aggregates.

The gradual development of EEG organizations throughout the world has been a natural evolution. The first society was started in Great Britain with the initiative of Dr. Grey Walter and under the able presidency of Nobel laureate, Prof. E. D. Adrian. This was followed by the Eastern Association of Electroencephalographers and then by the American Electroencephalographic Society, which stimulated the organization of two other sectional groups, the Central Association and the Western Association, on this continent. I have just heard that a Southern Section is in gestation. In Europe there was soon organized a Scandinavian Society under the direction of Drs. Buchthal and Hertz. Recently an EEG Society for French-speaking countries has been organized by Dean Beaudouin and his colleagues in Paris. An Italian Society has also been organized under Drs. Gozzano and Moruzzi.

These various national societies are integrated by an international committee which was formed at the first International Congress held in London in June 1947. This committee, which serves as a federating body for the national societies throughout the world, is under the able chairmanship of Dr. Grey Walter. As an outcome of this organization, an international journal was founded with a representative editorial board from many countries. Considerable progress has already been made in our attempt to bridge political barriers existing between our distant colleagues, including those whose extensive work in this field has been hitherto difficult of access to most of us.

At the first Annual Dinner last year at this time, there were reminiscences of the beginnings of electroencephalography in this country—an historical interlude. At this meeting, I would like to turn your eyes toward the future, "charting the sea of brain waves." Perhaps a better title would be "a theoretical interlude."

The past 15 years have largely exhausted the descriptive phase of this relatively new field of investigation. At this level of exploration we have yet to consolidate our gains by clarifying definitions of terms employed, but there is probably little more to be added to our existing descriptive knowledge of the various rhythms and wave forms to be recorded from the cerebral cortex under a wide variety of conditions, normal and abnormal (*2, 30, 32, 33, 40, 55*). The terms alpha, beta, gamma, delta, and even perhaps theta have a fairly definite meaning to most investigators. Random spikes and sharp waves, rhythmic spike and dome patterns, or sharp and slow wave complexes also have a fairly definite descriptive meaning. The electrical patterns characteristic of sleep, coma, and destructive or degenerative lesions of the brain, as well as those characteristic of increased excitatory states, epileptic activation, and local discharging lesions, are readily recognized. These well-established empirical relationships have made electroencephalography a useful diagnostic aid in neurology, neurosurgery, and psychiatry, but this usefulness will stagnate unless more of our energies are channeled in a different direction during the coming years.

We have made very little progress in our understanding of the fundamental significance of brain

Presidential address delivered before the second annual meeting of the American Electroencephalographic Society, Atlantic City, June 1948.

waves during the past 10 years. The war can be held largely responsible for the lapse in fundamental research in this field, as in many others in which application to the more urgent problems of military medicine seemed remote. There is, however, another reason which is less excusable. Preoccupation and promotion of large-scale, mass-production, brain-wave factories for the clinical use of electroencephalography have left many competent workers little time to contemplate the significance of what they are doing. Instead of representing a stimulus to more intense fundamental investigation, clinical applications have drawn many of us away from basic research. They have lured into this field many more practical-minded men who have neither the background nor the interest to make significant contributions to our understanding of brain function through studies of its electrical activity. The outcome has been a number of pseudo-scientific clinical investigations which have served only to burden editors and readers of scientific journals without providing a great attraction to more serious-minded investigators concerned with the fundamental aspects of brain function. However, there are a few glimmers of light in the fog. Some may be beacons to which we may set our course; others may turn out to be warnings of rocks ahead.

What is the functional significance of these slow, rhythmic, potential waves derived from neuron aggregates throughout the nervous system? Compared to the familiar action potential of less than one-millisecond duration which signals the passage of a nerve impulse along a nerve fiber, their duration is of a different order of magnitude, ranging from about 20 to several hundred times as long. Certain of the more prolonged waves may be lengthened by the process of temporal dispersion of a volley of shorter waves not perfectly synchronized in time, but even when recorded with microelectrodes (though we need many more such studies), the rhythmic waves are still many times longer than action potential spikes. Furthermore, they may wax and wane in amplitude, not always showing the explosive "all or none" character of the conducted nerve impulse. Some of this waxing and waning is due to the progressive recruitment and dropping out of nerve units in synchronized mass activity. It is highly probable from the evidence at hand that individual cell potentials also do not always show this "all or none" property. Brain waves cannot be identified, therefore, with aggregates of fiber potential spikes, although such aggregates do produce some of the cortical potential waves recorded under certain circumstances, such as in the evoked potential from the sensory cortex following tactile stimulation.

Electrophysiologists of the "unitarian" school would have us believe that all of the secrets of the electrical activity of neuron aggregates lie hidden in the fundamental properties of single isolated neurons (*26*). This may be true if we add the basic mechanisms of neuronal interaction in synaptic networks or by potential field effects in neuron pools. Rhythmic slow waves have been recorded from isolated axons by many investigators including Monnier and Coppée (*45*), Arvanitaki (*7, 8*), and, more recently, by Lorente de Nó (*41*) in his studies of factors affecting the resting potential of nerve membranes. These fluctuations in membrane potential underlie alterations in the local excitability of the nerve. Slow potential waves are also recorded from sympathetic ganglia and from the spinal cord which are considered to represent polarization changes at the synapse, or synaptic potentials. These also have been shown to be related to excitability changes at the synapse (*10*). Are the spontaneous electrical rhythms of the cortex, then, to be considered of this nature? Do they represent spontaneous rhythmic fluctuations in the local excitability of neuron aggregates in the cortex, a sort of semisynchronized conglomeration of synaptic or cell potentials? Do they affect the excitability of these cells as do changes in the polarization of an isolated axon? This seems a likely working hypothesis (*34*). In its favor are the experiments of Bishop (*16*), showing some form of rhythmic fluctuation in the excitability of the occipital cortex at the frequency of the alpha rhythm in animals, and the experiments of Adrian and Moruzzi (*6*), which indicate that volleys of action potentials may be set off down the pyramidal tract by slow potential waves recorded from the motor cortex. The subjective enhancement of the intensity of light flickering at about 10 per second (the "Bartley effect") gives further evidence in man that rhythmic fluctuation in cortical excitability may accompany the potential changes recorded as the alpha rhythm (*11*). Much more needs to be done, however, before a clear conception of not only the nature but the functional significance of these spontaneous electrical rhythms may be obtained.

Do these electrical brain rhythms represent spontaneous autonomous activity of cortical neurons, or do they depend upon continuous activity maintained by nerve impulses reverberating in closed chains of neurons? Here again, if we turn to the properties of single neurons, we find that they are capable of autonomous rhythmic activity without reverberating reactivation. Isolated mammalian nerves, however, do not show the property of autonomous rhythmicity except under rather special conditions (e.g. decalcification, injury, cathodal polarization). But, there

ay be certain specialized cells within the cerebral ortex which do have the property of autonomous hythmicity.

Experimental undercutting of the cortex, or thamic and possibly also hypothalamic lesions, has een shown to cause a marked reduction or abolition f spontaneous cortical rhythms. This has been inerpreted by some to prove that thalamocortical revererating circuits are necessary for the maintenance of he electrical activity of the cortex. However, the olated cortex is still capable of sustained rhythmic ctivity when activated chemically (small amounts of rychnine or acetylcholine) or in response to elecical stimulation. Bremer (*17–20*) has given us the erm "tonus corticale" to describe the effect of afferent flow upon the maintenance of cortical rhythms and oes not believe they are dependent upon reverberatng circuits. Thalamocortical circuits do serve to enance and to time or pace the rhythms of the cortex nder certain conditions, but spontaneous electrical ctivity of the cortex is not entirely dependent upon hem. This leaves the possibility of short intracortial circuits, which may also play a role, but direct roof is lacking even though the mathematical possiilities as developed by Wiener, McCulloch, and Pitts re most stimulating (*42, 48, 49*).

Another concept which deserves more consideration our thinking about brain waves is the electrical field ffect in contiguous neurons, even when their neuronal nterconnections have been completely interrupted. erard and his co-workers have shown such effects in he frog's brain after treatment with caffeine (*39*), nd Bremer has shown that a similar effect operates in he strychninized spinal cord of the cat (*21*). Monnier nd I were able to excite an isolated crustacean axon erely by placing it in close contiguity with another xon of the same type which received an electrical timulus (*38*). This was called an "artificial synpse," later referred to as "ephaptic conduction" by rvanitaki (*7, 8*).

Many others have shown that action potentials in ontiguous nerve fibers do interact to affect the exitability of adjacent fibers (*44, 50*), even though in ninjured myelinated nerves actual excitation does ot occur (though it may occur at a region of injury, as demonstrated by Granit and co-workers, *31*). rvanitaki showed that when two nerve fibers are iring spontaneously in a rhythmic manner, they begin o fire synchronously at the same frequency when they re placed in close juxtaposition. These field effects ust occur not only in the normal brain but especially ith the very-high-voltage electrical discharges devel-ped during epileptic activity of the brain. To what extent they may affect the normal integrative function of the brain or contribute to the spread of epileptic discharge has yet to be explored.

The recent revival of interest in automatic frequency analysis by Grey Walter and his associates (*53, 54*) and further studies of photic driving have led to the revival of the analogy of the brain as a series of loosely linked oscillators. According to this view, a given group of nerve cells tends to discharge rhythmically at a relatively fixed frequency, and under normal conditions it cannot be driven much beyond these limits. However, they are not sharply tuned, since adjacent oscillators tend to get into step if left undisturbed, apparently by some form of mutual interaction. Various complex wave forms are thought to be the resultant synthesis of potential patterns from a number of different neuronal aggregates oscillating at a variety of different frequencies. Dawson and Walter (*24*) have been able to synthesize a number of the wave forms common to electroencephalography, including the spike and dome pattern of petit mal, by mixing the right amounts of 9 or 10 different frequencies in an artificial model of the head.

This is a conception which must be continually borne in mind when attempting to understand the underlying structure of brain waves, but its validity needs more direct testing in each case. Even though it may be possible to analyze the complex forms of brain waves into a number of different sine-wave frequencies, this may lead only to what might be termed a "Fourier fallacy," if one assumes *ad hoc* that all of the necessary frequencies actually occur as periodic phenomena in cell groups within the brain. However, frequency analysis, when related at all times to the original recording, is proving to be a useful adjunct to the electroencephalographer's armamentarium, if and when the various spectra thus obtained can receive adequate and valid interpretation.

All of this concerns the possible basic mechanism of brain waves but does not touch the problem of their functional significance. Walter (*52*) has made the intriguing proposal that they represent a perceptual scanning system which oscillates rhythmically when undisturbed by patterns of centripetal impulses. He has constructed an electronic model which reproduces the blocking of the alpha rhythm by visual patterns in a most suggestive manner. This conception may not be incompatible with Bremer's (*23*) view that brain waves represent a tonic background of excitatory activity in nerve centers anywhere, which serves to keep them in a state of readiness to respond (see also Adrian's excellent discussion, *1*).

What, then, of the abnormally slow waves recorded from the cortex during states of apparent inhibition of cortical function—action which seems to produce decreased rather than increased responsiveness? We

have the view of Beritoff (*15, 51*) that they represent activation of the "neuropile," which has a special inhibitory function. It seems possible, therefore, that brain waves are related in some obscure manner to the background excitatory and inhibitory states which set the stage for processes of attention to certain aspects of the constant play of afferent impulses as well as a preparation of the readiness to respond.

Berger was the first to recognize the relationship between electrical rhythms of the brain and processes of attention (*13, 14*). He thought that the disappearance of the alpha rhythm with attention represented the general inhibition of cortical activity which must accompany the focusing of attention. Adrian then showed that the disappearance of the alpha rhythm was probably not a true inhibition of cortical activity but a desynchronization of unit discharge (*3–5*). However, Adrian confirmed the close relationship which we have all observed between the alpha rhythm and concentration of attention or to certain types of generalized "tension state." The low-voltage, fast, asynchronous waves which are recorded from the attentive or alerted cortex, the regular alpha rhythm from cortex in wakeful repose, and the very slow waves which characterize the cortex in sleep or coma should give a clue to the functional significance of this constant electrical activity (*9, 25, 28, 29, 35*). If one assumes that these different wave patterns represent different organizations of activity in the same neurons, then the asynchronous pattern of the alerted cortex may indicate a more highly differentiated function of cortical units under these conditions, an essential condition of highly integrative function. The slow waves would then represent the synchronous activity of large masses of neurons, a mechanism which would abolish their differential individual activity, consistent with obvious impairment in the integrative and differential functions of the brain in deep sleep or coma.

It is hardly conceivable that the central mechanism of attention lies in the cortex. Except for certain individuals whose attention seems to be controlled chiefly by the loudest or brightest stimulus presented to them, most persons are able to exert a degree of control over the sounds they hear and the visual impressions they choose to see, or even to become relatively unaware of the outside world when the attention is directed to images or ideas which occupy the central stream of consciousness. There must be some centrally placed integrating center which is capable of a general control, inhibitory and facilitatory, upon the multitude of potentially conscious processes whose patterns of elaboration lie in the cortex. We should probably look for these centers in structures which are most critical to the existence of consciousness itself, namely, certain structures in the general region of the third ventricle.

Morison and Dempsey (*46*) found a centrally placed region of the thalamus, the intralaminar system, which is capable of exerting a widespread control over the electrical rhythms of the brain. With Droogleever-Fortuyn (*36*), we have confirmed and extended these observations to include the reticular nucleus in a thalamic reticular system which may control the electrical rhythms of the entire cortex, or of specific regions alone. We believe that this is a portion of the brain-stem inhibitory and facilitatory system recently brought to light in the brilliant studies of Magoun and Rhines (*43*). From this same system the electrocortical pattern of petit mal epilepsy—a type of seizure which is characterized chiefly by a lapse of consciousness—can also be reproduced. May it not be, therefore, that in this thalamic reticular system are the specific central controlling mechanisms for processes of attention, and that the spontaneous rhythms of the cortex may in some manner reflect the influence this thalamic system exerts upon the function of specific cortical areas involved in the momentary limelight directed here and there in the central stream of consciousness? More generalized diffuse processes affecting the alertness of the cortex as a whole, as in the sleep-wake mechanism, seem to be controlled from subthalamic, hypothalamic, or possibly even upper mesencephalic portions of this central integrating neuronal network, the importance of which, as a regulating center for motor responses, as well as for the control of mental processes, is gradually being clarified.

There are many other important questions in electroencephalography which might be asked and which would receive answers as unsatisfactory as those I have attempted to make. The relations between brain waves and brain metabolism, the influence of electrolytes, hormones, etc. (*27, 47*), is a chapter in itself. It is my hope, however, that the thinking of the members of this Society has been stimulated so that we and our confreres throughout the world shall be able to write the finale on the purely descriptive stage of our development.

We must push ahead during the coming years toward more basic research on the functional significance, as well as on the neurophysiological, anatomical, and physiochemical mechanisms underlying the electrical activity of the brain.

Electroencephalography, properly conceived, is not the study of brain waves per se. It is a recently developed branch of electrophysiology concerned with the functional properties and laws governing the behavior of neuronal aggregates and networks. Attempts have been made to formulate a mathematical

sis for the complex interrelationships involved. It too early to evaluate properly the scope and significance of these developments. Before us lies a new attack on some of the most important problems of man behavior, the neuronal mechanisms underlying processes of awareness, thought, and action.

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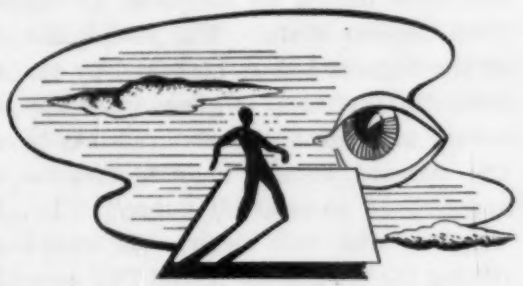

NEWS and Notes

Christopher L. Wilson, until recently a professor of chemistry at the University of Notre Dame, has accepted a similar position at Ohio State University.

C. Sidney Burwell, dean of the Faculty of Medicine, Harvard University, since 1935, will resign on February 1. Dr. Burwell will continue as research professor of clinical medicine and is planning to resume his work on problems connected with heart disease.

Thomas B. Cameron, assistant professor of general and inorganic chemistry, University of Cincinnati, has been granted a leave of absence to act as associate chemist with the Chemistry Division of the Argonne National Laboratory, Chicago.

Herbert S. Conrad, of Princeton University, has been appointed chief of the Research and Statistical Service, Office of Education. Prior to his new appointment, Dr. Conrad had served on the College Entrance Examination Board and for the past 18 months was also educational consultant to the Secretary of War.

Warren Andrew, professor of anatomy at George Washington University, has been appointed visiting professor at Washington University School of Medicine in the absence of **Mildred Trotter,** professor of gross anatomy at that University. Dr. Andrew is replacing Dr. Trotter for the 6-month period beginning September 1. Dr. Trotter is currently assigned as anthropologist for the U. S. Army in the Territory of Hawaii. Her headquarters will be the Scofield Barracks near Honolulu, on Oahu, until June 1949.

John S. Hall, formerly associate professor of astronomy and physics at Amherst College, has been appointed head of the Division of Equatorial Instruments, U. S. Naval Observatory, Washington, D. C.

Philip A. Butler, aquatic biologist in the Shellfishery Section, U. S. Fish and Wildlife Service, Annapolis, Maryland, has been appointed chief of the newly established Gulf Oyster Investigations. Dr. Butler will serve as a Federal consultant on shellfishery problems for the Gulf States and conduct a research program at the Pensacola Laboratory of the Fish and Wildlife Service.

J. B. Sumner, who is on sabbatical leave from the Department of Biochemistry, Cornell University, will spend the period from October 15 to December 15 visiting educational institutions in the South and Southwest.

Charles D. Michener, formerly an associate curator at the American Museum of Natural History, New York City, has been appointed associate professor of entomology at the University of Kansas, Lawrence. He expects to continue his studies of evolutionary problems in the bees and saturniid moths in connection with systematic, morphological, and distributional investigations of these groups.

Virgil D. Cheyne has resigned from the College of Dentistry, University of Iowa, to become professor and executive officer of the Department of Oral Diagnosis and Treatment Planning at the School of Dentistry, University of Washington, Seattle. Dr. Cheyne is known for his work in the topical application of fluorine to human teeth.

Awards

Edwin H. Colpitts, director of the Engineering Foundation, New York, has been named as recipient of the 1948 Cresson Medal. The Medal, one of the highest honors bestowed by the Franklin Institute, is given "for discovery or original research, adding to the sum of human knowledge, irrespective of commercial value." Dr. Colpitts, who will receive the award during the traditional Medal Day ceremonies in Philadelphia on October 20, will be recognized for his pioneering achievements leading to the development of practical systems of long distance communication, both by wire and radio.

Ralph Bown, director of research, Bell Telephone Laboratories, has been selected to receive the Medal of Honor of the Institute of Radio Engineers. The Institute's Medal of Honor is awarded in recognition of distinguished service rendered through substantial and important advancement in the science and art of radio communication. Dr. Bown's work, concerned with various aspects of radio broadcasting and ship-to-shore and overseas telephony, brought him an international reputation in the communications field.

The Shell Development Company has been named winner of the 194 award for Chemical Engineering Achievement, sponsored by the M Graw-Hill publication, *Chemical Engineering.* The Shell organization, research and development affiliate of Shell Oil Company and Shell Chemical Corporation, was recognized for its successful commercial synthesis of glycerine, its long-time program in petroleum chemicals pioneering, and other outstanding applications of chemical engineering in the petroleum industry. Presentation of the award will be made in New York City on November 10 at a dinner following the annual meeting of the American Institute of Chemical Engineers.

Colleges and Universities

The Laboratory of Nuclear Studies at Cornell University will be dedicated next week during celebration of the University's 80th anniversary. The featured address of the ceremonies will be made by Enrico Fermi, of the University of Chicago, whose topic will be "The Promise of Nuclear Studies for the Future." Others participating in the dedication, at which Neal Dow Becker, chairman of the Board of Trustees of the University, will preside, are President Edmund E. Day; J. Carlton Ward, Jr., of the Board of Trustees; Robert F. Bacher, Atomic Energy Commission; Rear Adm. Thorvald Solberg, Chief of Naval Research; and R. R. Wilson, director of the Laboratory.

The School of Mines and Metallurgy, University of Missouri, has announced a number of changes in its Physics Department staff, effective with the fall term. Leon E. Woodman, professor and chairman of the Department for the past 29 years, who has become professor emeritus, will be succeeded by Harold Q Fuller, professor of physics. Edward Fisher, formerly assistant professor of physics at the University of Wyoming, has been appointed professor, and Louis K. Lund, who recently completed his graduate work at the University, has been made assistant professor.

The New School for Social Research, 66 West 12th Street, New York City, announces the opening this fall of a Research Institute in Biochemistry under the direction of the internationally famous Hungarian scientist and Nobel Prize winner, Albert Szent-Györgyi, and his colleague, Colomon Laki. The Institute will conduct a research laboratory in Woods Hole, Massachusetts, and report its findings in lectures at the New School. Research will be centered in the study of muscles, physics of the living state, and study of the blood. The Institute will also be engaged in application of the results of basic research to heart ailments and blood diseases.

A first series of four weekly lectures by Dr. Szent-Györgyi will open on Friday, October 15. These lectures, to be known as "The Hecht Lectures on General Biology," are named for the late Selig Hecht in recognition of his work both as scientist and as teacher. They will deal with the modern problems of biology and sum up results of recent research in terms understandable to the average layman.

Lectures offered to specialists will include those on the theory of the solid state based on the quantum mechanical study of macromolecules, to be given by Z. Bay, experimental physicist, and J. Gergely, physicist, and a series on the physics of contraction with special regard to thermodynamics, by Dr. Laki, biochemist, L. Varga, biologist, and E. Milhályi, biochemist. Other lectures will deal with the chemistry of contractile matter and enzymic actions, the electron microscopy of contractile proteins, and a comparative study of the muscle cell as a whole, mainly by spectroscopic methods.

Dr. Szent-Györgyi, formerly professor of biochemistry in Budapest, won the Nobel Prize in medicine and physiology in 1937 for the discovery of vitamin C and fumaric acid catalysis, and has since been honored for his researches in biological oxidations, vitamins, and muscular contraction.

Besides those named, other scientists in the group include A. Lajtha, chemist; G. Matoltsy, zoologist; Andreas Szent-Györgyi, biologist; G. Rozsa, specialist in electron microscopy; and S. Rath, specialist in translating laboratory methods into limited mass production of the active substances.

Expansion of the science departments at Phillips University, Enid, Oklahoma, involving the completion of a $500,000 building and an increase in the teaching and research facilities, is under way. As a part of this program, representatives of the science departments have been conducting numerous field and inspection trips throughout the area surrounding the University as well as more extensive tours.

Through the cooperation of the Administration of the University, the Enid Chamber of Commerce, the AAAS, and the National City Christian Church of Washington, D. C., a group composed of 22 students and 3 professors attended the AAAS Centennial Celebration last month (see cover). Juniors and seniors given this opportunity included 8 biology, 8 chemistry, 3 geology, and 3 physics majors. They were accompanied by Andrew H. Montgomery, professor of chemistry; Donald E. Mitchell, professor of physics; and Vernon R. Baker, professor of geology. It was possible for the students to make the 3,000-mile round-trip journey at a minimum of expense by use of the school bus and by using the annex of the National City Christian Church as living quarters while in Washington.

Eugene S. Briggs is president of Phillips.

The Graduate Division of the College of Engineering New York University and the **Graduate School of Stevens Institute of Technology** are undertaking the second year of their unique cooperative program of courses on "Fluid Dynamics of Aircraft and Ships." Begun in 1947, the program leads to a Master's degree and trains engineers in applying basic sciences to both aeronautical and nautical engineering. During the course, graduate engineers have an opportunity to become familiar with several branches of the two schools and with the NYU Guggenheim Wind Tunnel and the Steven's Experimental Towing Tank.

Successful completion of 15 courses is necessary for a Master's degree. The 10 required courses, given by the faculties of both schools and experimental stations, include mathematics, theoretical and applied fluid mechanics, thermodynamics, and experimental methods. Five elective courses, chosen on the basis of the student's individual need, are selected from a large list available at both institutions.

Industrial Laboratories

A scientific "lend-lease" program aimed at speeding up all phases of atomic energy research has been launched by the Argonne National Laboratory and the Westinghouse Electric Corporation. The new program will enable Argonne to select Westinghouse specialists in any required field of research or engineering for work at the Laboratory on a leave-of-absence basis. In full operation the project should require the services of 20–30 Westinghouse men. Initial assignments under the new "lend-lease" program include: E. Bruce Asheraft, from the Westinghouse Research Laboratories; Adolph H. Toepfer, from the East Pittsburgh Works; and N. J. Palladino, of the South Philadelphia Works.

S. David Bailey, formerly of the Iowa State Teachers College, has joined the staff of Smith, Kline & French Laboratories as head of the physical chemistry section. In his new position Dr. Bailey will be responsible for the scientific and administrative operations of his section, which is concerned with the application of physical-chemical methods to the development of new drugs.

The Du Pont Company has begun the small-scale manufacture of titanium metal for commercial use at a pilot unit now in operation at Newport, Delaware. While the metal has previously been available for research purposes from the U. S. Bureau of Mines, the difficulty of extracting the metal from its ores, rutile and ilmenite, has prevented full exploration of its industrial and engineering applications. Because of titanium's properties of lightness, strength, corrosion resistance, and a high melting point, its alloying possibilities are numerous. Reports of the Bureau of Mines and other research organizations have indicated that one of its major uses might be in high-speed planes.

The metal is now being produced in sponge form, but the Company will soon provide it in the form of ingots weighing up to 100 pounds.

Meetings and Elections

The 26th annual forum sessions of the Academy of World Economics will be held on the evenings of October 6–7 in the Hall of Government, George Washington University, and at the Copley Lounge, Georgetown University, Washington, D. C. The current sessions on "Some Effects of Technological Change on the Social Sciences" will be held in conjunction with Section K of the AAAS, and with the National Social Science Honor Society, Pi Gamma Mu.

The October 6 session at George Washington will consider the effects of technological change on economics. Participating in this program will be: W. D. Evans, chief, Office of Labor Economics, Department of Labor, speaking on "Technological Change and Productivity"; O. E. Baker, professor of human and natural resources, University of Maryland, discussing "The Concentration and Dispersion of Population"; and J. Carlton Ward, Jr., chairman of the Board of the Fairchild Engine and Airplane Corporation, discussing "Military Technology and the National Economy." Capt. W. D. Rowley, USN, chief of the Technological Progress Branch, Industrial College of the Armed Forces, will preside at this meeting.

The October 7 session scheduled for Georgetown will develop the effects of technological change on politics. Participants will include Dael Wolfle, secretary, American Psychological Association and the Inter-Society Committee for a National Science Foundation, who will discuss "Scientific Research as a Responsibility of Government"; John W. Brewer, professor of international law, George Washington University, speaking on "Political Philosophy and Practice"; and Rev. Edmund A. Walsh, S. J., regent of the School of Foreign Service, Georgetown University, whose topic will be "International Relations." Andrew J. Kress, of the Department of Economics, Georgetown University, will preside at this session.

Washington area members of the AAAS are especially invited to attend these forum sessions, as well as members from outside the city.

The Proceedings of the sessions will be published in the January 1949 issue of the quarterly journal of the Academy, *Social Science*. Information regarding the Proceedings and the journal may be obtained from: Donald P. Ray, Executive Secretary, The Academy of World Economics, Hall of Government, George Washington University, Washington 6, D. C.

The 31st annual meeting of the American Dietetic Association will be held in Boston, Massachusetts, October 18–22. The sessions, taking place in the Mechanics Building and Hotel Statler, convention headquarters, will explore means of achieving optimum nutrition for the earth's population. Session topics and their discussants include: "New Advances in Nutrition"—Charles G. King, scientific director, The Nutrition Foundation, Inc.; P. C. Jeans, professor of pediatrics, State University of Iowa; Leonard A. Maynard, director, School of Nutrition, Cornell University; E. Neige Todhunter, presiding; "Maternal and Child Health"—Harold C. Stuart, professor of maternal and child health, Harvard University Medical School; Nevin S. Scrimshaw, University of Rochester School of Medicine and Dentistry; Clement Smith, director of research on the newborn, Boston Lying-In Hospital; Stuart S. Stevenson, assistant professor of child health, Harvard University School of Public Health; Bertha S. Burke, presiding; "Diet Therapy"—Priscilla F. White, Alexander Marble, and Frank N. Allan, all of Boston; and Fredrick J. Stare, George W. Thorn, and George V. Mann, of the Harvard School of Public Health and Medical School; "The Motivation of the Human Being"—Margaret Mead, associate curator of ethnology, American Museum of Natural History; Alex Bavelas, Industrial Relations Section, M.I.T.; Mary E. Spencer, chief, Bureau of Health Information, Massachusetts Department of Public Health; and Ethel Walsh, social worker for the Peter Bent Brigham Hospital.

According to Helen A. Hunscher, Association president and head of the Home Economics Department, Western Reserve University, other sessions will include varied discussions from the history of nutrition and dietetics to the teaching of nutrition and dietetics to medical students. A large variety of exhibits of the latest trends in food preparation and food service equipment will be displayed in Mechanics Hall for the 3,000 experts in the dietetics field expected at the meeting. Election and installation of new officers and a preconvention meeting of the House of Delegates are scheduled for October 18.

The American Society for the Study of Arteriosclerosis will hold a scientific meeting October 31 and November 1 at the Hotel Knickerbocker, Chicago. The scientific sessions will be devoted to the presentation of 15-minute papers. A banquet has been scheduled for Sunday night, at which W. B. Kountz, president of the Board of Directors, will preside and C. J. Van Slyke, director of the National Heart Institute, will appear as guest speaker. Further information may be obtained from the secretary, O. J. Pollak, Quincy City Hospital, Quincy 69, Massachusetts.

A symposium on "Ultrasonics and Macromolecules" will be held at the Institute of Polymer Research of the Polytechnic Institute of Brooklyn on October 23. The program will include the following speakers: J. W. Ballou,

of the Du Pont Company (chairman) —"Opening Remarks"; Geoffrey Gee, British Rubber Producers Association —"Dielectric and Mechanical Properties of Polymers at High Frequencies"; Karl Sollner, U. S. Public Health Service—"Ultrasonic Mechanisms in Colloidal Systems"; Warren P. Mason, Bell Telephone Laboratories —"Mechanical Properties of High Polymer Liquids at Ultrasonic Frequencies"; and A. Wilson Nolle, University of Texas—"Mechanical Properties of Some High Polymers at Ultrasonic Frequencies."

The National Committee for Mental Hygiene will hold its 39th annual meeting November 3–4, at the Hotel Pennsylvania, New York City. The four scientific sessions will include discussions of problems emerging from the recent International Congress on Mental Health, the program of UNESCO and WHO, and the World Federation for Mental Health; evaluation of the Federal mental hygiene program; development and responsibility of the citizen for improvement of state psychiatric services; and foundations for positive mental health.

Presentation of the Lasker Award for 1948 for a significant contribution to the education of the physician in the psychological aspects of medical practice will be made at the annual luncheon scheduled for November 4. At this time a discussion will be held on the 10-year national program for mental health.

The 28th annual meeting of the Highway Research Board will be held this year December 7 through 10 at the building of the National Academy of Sciences and National Research Council, 2101 Constitution Avenue, Washington, D. C. It is expected that attendance at this meeting will exceed that at the annual meeting of the Board held in Washington last December when 853 persons registered and 125 technical papers and reports were presented and discussed at 24 separate public sessions. Thirty-six State Highway Departments, 31 colleges, 26 government bureaus, and 33 national associations were represented.

During the week of the meeting the 6 departments of the Board—Economics, Finance, and Administration; Design; Materials and Construction; Maintenance; Traffic and Operations; and Soils—will assemble and discuss the research aspects of the important problems confronting the highway industry as a whole. Many of the 67 project committees will also meet to discuss their research activities for the coming year.

The American Society of Naturalists at its meeting in Washington, D. C., on September 13, elected Tracy M. Sonneborn, of the Department of Zoology, Indiana University, president for 1949. Kenneth V. Thimann, professor of plant physiology at Harvard University, was elected vice-president.

A Symposium on "Yeasts in Feeding" will be held November 8–10 at the Hotel Pfister in Milwaukee, Wisconsin, under the joint sponsorship of Associates of the Food and Container Institute, the Brewers Yeast Council, the Yeast Industry, and the Quartermaster Food and Container Institute for the Armed Forces. The purpose of the symposium is to make available to food processors and food research personnel the most recent data and information relating to yeast and its suggested applications in foods for human as well as animal consumption. Technical papers will deal with yeast production, composition, nutritional aspects, and various uses for yeast products. J. M. Leinen, of the Jos. Schlitz Brewing Company, Milwaukee, is chairman of the local arrangements committee.

The 76th annual meeting of the American Public Health Association has been scheduled for November 8–12 in Boston, Massachusetts, according to Reginald M. Atwater, the Association's executive secretary. A program of over 300 papers, many to be given by the Nation's leading physicians, scientists, and public health authorities, has been planned for the 4,000 members of the Association expected to attend the meeting. Most of the meetings will be held in Mechanics Hall, where many scientific and commercial exhibits will be on display. The 29 related organizations of the APHA will also be meeting in Boston at the same time.

The Society of American Foresters will hold its annual meeting at the Statler Hotel, Boston, Massachusetts, December 16–18. According to Clyde Martin of Tacoma, Washington, president of the Society, the national meeting will open December 16 with individual sessions of the Society's 9 divisions dealing with private forestry, forest economics, forest recreation, forest products, forestry education, wildlife management, range management, silviculture, and public relations. Nonmembers interested in these specialized fields are urged to attend any of these sessions. On December 17 the 50th anniversary of professional forestry education in America will be observed with addresses by well-known forestry educators. Technical papers on forest practices in the Northeast will be given by representatives of Federal and State governments and the forest products industries at the final session on December 18.

Deaths

Kenneth L. Mahony, 41, professor of biology at the University of Kansas City, died of leukemia on August 21 while visiting in Mazomanie, Wisconsin.

Charles Dean Bunker, 76, curator emeritus of Modern Vertebrates at the Museum of Natural History of the University of Kansas, died September 5 in Lawrence, Kansas.

Lyda May Degener, 57, former head of the Department of Health Education and professor of physiology and hygiene at Wells College, died September 10 at her home in Ivyland, Pennsylvania.

Harry J. Patterson, 81, retired director of the University of Maryland Agricultural Experiment Station and one-time president of the Maryland Agricultural College, predecessor to the University, died September 11 in Boston, Massachusetts.

Arthur J. Roy, 78, chief astronomer of the Department of Meridian Astronomy, Carnegie Institution, from 1907 through 1936, and staff member of the Dudley Observatory, Albany, New York, died at his home in Albany on September 11.

Newton C. Jones, 43, manager of the Niagara Falls plant of the Du Pont Electrochemical Department, died of a heart attack September 13 in Niagara Falls, New York.

Fred Boerner, 59, professor of clinical bacteriology at the University of Pennsylvania, died September 16 at his Drexel Hill, Pennsylvania, home. Dr. Boerner had also served as laboratory director of the American Stomach Hospital and as consultant bacteriologist for the Pennsylvania Department of Health.

Ruth Fulton Benedict, 61, noted author and professor of anthropology at Columbia University, died September 17 at New York Hospital, New York. A specialist in the study of behavior patterns, Dr. Benedict had spent the summer in Europe as director of a research project in contemporary cultures for ONR and Columbia.

Otis Hamilton Lee, 45, professor and chairman of the Philosophy Department at Vassar College, died September 17 in Peacham, Vermont, of a heart attack.

The Philadelphia Section of the American Chemical Society will again this year sponsor special noncredit courses designed to advance the training of chemists in the Philadelphia area. The course "Pharmacology for Chemists," consisting of 10 two-hour weekly courses beginning October 18, will be given by Carl F. Schmidt, of the University of Pennsylvania Medical School. It will provide a basic knowledge of pharmacology for chemists who do not have extensive training in the biological sciences. A survey course on "Recent Developments in Inorganic Chemistry" will be offered on successive evenings beginning October 19. Lecturers include H. S. Booth, W. C. Fernelius, J. C. Bailar, Jr., L. C. Hurd, L. F. Audrieth, R. Word, W. C. Schumb, C. D. Coryell, and R. E. Kirk.

Classes will be located at the Philadelphia College of Pharmacy and Science, 43rd and Kingsessing Avenue, and will be open to both members and nonmembers of the Philadelphia Section. Information may be obtained from J. F. Gall, Whitemarsh Research Laboratories, Pennsylvania Salt Manufacturing Company, Wyndmoor, Pennsylvania.

An evaluation of many tests used for detecting cancer in its early, curable stages will be made in a project recently announced by the National Cancer Institute. The specific aim of the program will be to discover which of the diagnostic tests are dependable and simple enough for widespread use, to refine the more promising ones, and to develop new tests. Discussions between Institute personnel and consultants from medical schools and other institutions over the past year have resulted in the organization of a plan in which laboratory and clinical studies will be made simultaneously by the cooperating organizations. When promising tests are indicated, they will be applied, first, to a small number of previously investigated cases and, later, if justified, to thousands of persons, with or without cancer, who pass through the cooperating institutions. One of the agencies which will be put to extensive use is the U. S. Public Health Service Medical Center at Hot Springs, Arkansas, where the Institute now operates a pilot cancer detection unit.

The Laboratorio de Investigaciones Histológicas e Histopatológicas which was in charge of the late Spanish scientist, P. del Rio Hortega, until his death and which subsequently has been directed by M. Polak, has recently moved to Montevideo 81, Buenos Aires, where, under the patronage of the "Fundación Roux," it will continue with the development of its research and teaching activities.

The Department of the Army has established a program of particular interest to scientists who hold Reserve commissions in the Army and who are professionally engaged in teaching or research and development. The objectives of the program are: (1) to maintain the useful affiliation of scientists with the Organized Reserve Corps; (2) to provide peacetime Reserve assignments for these officers, enabling optimum utilization of their education, experience, and skills; (3) furnish mobilization assignments which will fully utilize their talents; and (4) to prepare these officers adequately for mobilization.

The Technical Services of the Department of the Army submit to these Research and Development Reserve Groups research problems and projects which pose an intellectual challenge to the members of the group. At the same time the program provides members of each group with a type of training which is in keeping with their scientific and technical competence, rather than the traditional training session in which scientists have little or no interest.

The program is new and is being carried out only in those areas where there is a definite local interest. To date, 8 Research and Development Reserve groups have been activated; 16 additional groups are in process of activation. Others are in the initial stages of formation. Several of these groups have been formed in communities in which large universities, industrial research laboratories, or private research foundations are located. Typical localities are Chicago, Illinois; Wilmington, Delaware; Newark, New Jersey; Houston, Texas; Washington, D. C.; Manhattan and Lawrence, Kansas; Champaign-Urbana, Illinois; Pittsburgh, Pennsylvania; Denver, Colorado; and Detroit, Michigan.

Provision is made for research projects of interest to all categories of scientists—chemists, physicists, engineers, geologists, geographers, psychologists, mathematicians, and all of the biological scientists.

Reserve officers who are presently engaged in civilian research, teaching, or industrial development or who, in the past, have had specific research experience are eligible to make application for assignment to a Research and Development Reserve Group. A group may be activated wherever there are 20 or more qualified officer scientists who desire to participate in the program. A subgroup may be formed with only 10 qualified members. The program is under the general direction of the Research and Development Group, Logistics Division, General Staff, U. S. Army. The entire program is outlined in Department of the Army Circular 127, dated May 5, 1948. Inquiry about formation of such a group or admittance to a group already activated should be made at the local

level to the Unit Instructor or to the Senior Army Instructor, Organized Reserve Corps.

The Oak Ridge Institute of Nuclear Studies has announced that four additional radioisotope courses have been scheduled for this fall and winter. The additional courses are being offered in view of the fact that, although more than 300 qualified individuals applied for entrance to one of the three courses held during the summer months, there were only 96 places in these three courses.

Dates for the new courses and the fields of interest which will have priority follow: October 25, industrial personnel; January 3, government personnel; February 14, medical personnel; March 14, general.

Applications for the courses are now being accepted. Additional information and application blanks may be obtained from Dr. Ralph T. Overman, Head, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tennessee.

The current Archaeological Expedition to the Southwest by the Chicago Natural History Museum has revealed "four centuries of missing Indian history." According to Paul S. Martin, expedition leader and chief curator of anthropology, this year's expedition has "struck paydirt." With his associates, Dr. Martin has been investigating the little-known culture of the Mogollon and Pine Lawn Valley near Reserve, in the mountainous, southwestern section of New Mexico. In previous diggings, Dr. Martin had discovered that the founders of the Mogollon culture settled in this Valley some 6,000 years ago. Earlier, he had traced their life as roving, hunting bands to the pit-house villages of 500 A. D. Traces of the Mogollon culture from the period 500–900 A. D., however, were unknown until Dr. Martin's recent findings.

The newly discovered pit-house (a cellar with a roof) is unlike others found in this area. The Mogollones built deep, rectangular houses with long, stepped passage-entryways facing east. Foodstuffs, no longer stored in pits dug in the floor, were more conveniently placed in the walls. For the first time delicate and well-executed Mogollon decorated pottery appears, in contrast to the long history of plain, undecorated artifacts.

Japan's three major scientific and technological societies are described in a report recently prepared by the staff of the Supreme Commander of the Allied Powers. The societies described are: the Imperial Academy, founded in 1897 and now under the supervision of the Ministry of Education, which aids scientific development by subsidizing or conducting research, publishing scientific works, and fostering international intercourse of ideas; the National Research Council, organized in 1920, which advised the Japanese Government on worthwhile scientific research and the extent to which such work should be state-supported; and the Japanese Society for the Promotion of Science, formed in 1931. This last group was formed with the purpose of keeping Japan's "technological and ideological progress in phase with the moving world events."

Historical summaries of Japan's three major science organizations are included in the new report, together with organizational details, expenditure records, outstanding researches conducted, publications and membership lists. The report, PB 92127, *Scientific and Technological Societies of Japan*, sells for $11.25 in photostat form, $3.75 in microfilm. Orders should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., accompanied by check or money order payable to the Librarian of Congress.

A new dental film in color, "Dental Amalgam—Failures Caused by Moisture Contamination," has just been completed at the Natural Bureau of Standards. The 16-mm sound film, prepared under the joint auspices of the Bureau and the Research Commission of the American Dental Association, is the second of a series of technical films prepared for dental and allied professions. It shows how moisture contamination, usually produced by mixing amalgam in the palm of the hand and by condensing amalgam in a wet field, arises and describes a satisfactory technique for the prevention of contamination.

The film is available either as a loan or purchase through the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C. It is advisable that loan requests be made at least 30 days in advance of any projected showing.

Correction: In the article by Dr. Millikan entitled "The Progress of Physics From 1848 to 1948" (*Science*, September 3, p. 230) the last part of the fifth paragraph should have read: ". . . Ampere, the Frenchman, in the 1820's had developed that field with great skill and insight; while England's unsurpassed experimentalist, Faraday, had in 1831 discovered electromagnetic induction and in 1834 had laid the secure foundation for the whole field of electrolysis."

Make Plans for—

4th Annual National Conference on Industrial Hydraulics, October 20–21, Hotel Sheraton, Chicago, Illinois.

American Standards Association, 30th annual meeting, October 20–22, Waldorf-Astoria Hotel, New York City, New York.

American Association of Textile Chemists and Colorists, 27th national convention, October 21–23, Sheraton Bon Air Hotel, Augusta, Georgia.

National Metal Congress, American Society for Metals, October 25–29, Benjamin Franklin Hotel, Philadelphia, Pennsylvania.

Gas Discharge Conference, October 27–29, Brookhaven National Laboratory, Upton, New York.

American Institute of Chemical Engineers, annual meeting, November 7–10, Pennsylvania Hotel, New York City, New York.

Geological Society of America, November 11–13, Pennsylvania Hotel, New York City.

2nd International Symposium on Feelings and Emotions, sponsored by the Loyal Order of Moose in cooperation with the University of Chicago, October 28, Mooseheart, Illinois; October 29–30, University of Chicago, Chicago, Illinois.

Comments and Communications

Bursts of Solar Noise at 45 Mc Accompanying the Large Sunspots of 1947

The recent interest aroused during the present period of solar activity in the investigation of radiation of radio frequencies from the sun, for the most part of microwave dimensions, suggests that some results obtained with relatively simple apparatus at the Cosmic Terrestrial Research Laboratory in Needham in the region of 45 mc may be of interest.

The receiving antenna on the roof of the laboratory consisted of a single dipole tuned to the 40- to 50-mc band, erected at an angle to the horizontal of 45° atop a vertical mast. The longitudinal axis of the dipole was directed north and at this latitude (42°.4) was therefore approximately parallel to the earth's axis. Considering the broad loop pattern of the single dipole, it may be said that the antenna was thus broadside to the diurnal arc of the sun and thus required no mechanism for rotation. Since the extreme range of solar declination is from −23°.3 to +23°.3, little variation in reception could be expected from day to day or month to month on account of change in solar declination.

Furthermore, the mast supporting the dipole was arranged to be rotated through 180°, thus making it possible, for check purposes, to direct the axis of the dipole at any moment toward the sun for a determination of a null point of reception. The transmission line from the dipole consisted of a RG 59U shielded line. This was connected to a Hallicrafter S36 receiver tuned approximately to 45 mc, a band selected free from receivable broadcast reception at the laboratory. The recorder used was a Cambridge Instrument thread recorder, registering momentarily dot records of the position of the galvanometer pointer at intervals of 1 min. At the occasion of the very large sunspot of March 9, 1947, passing near the central meridian of the sun, a burst of solar noise occurred soon after sunrise, exceeding the limits of the scale of the recorder, which was slightly in excess of 2 microvolts. The burst lasted for somewhat over 1 hr and was followed by additional bursts with off-scale readings between 3:00 and 5:30 P.M., subsiding at sundown.

Again on the following day, March 10, 1947, shortly after sunrise, a fresh burst occurred, again sending the needle off scale between 10:00 and 11:00 A.M. This disturbance subsided near noon, but was followed between 3:00 and 5:00 P.M. by two additional bursts of approximately 2 microvolts equivalent CW reception at the receiver. During each of these bursts, the dipole was turned in azimuth 180° to obtain a null point, whereupon the recorder immediately fell to near zero, corresponding to the threshold value of residual extraneous noise. This gave assurance that the disturbances noted were definitely of solar origin and were undoubtedly associated with the large sunspot. Minor bursts of less significance occurred on March 11 and 13. A graphical representation for the interval March 2–March 12 is shown in Figs. 1 and 2.

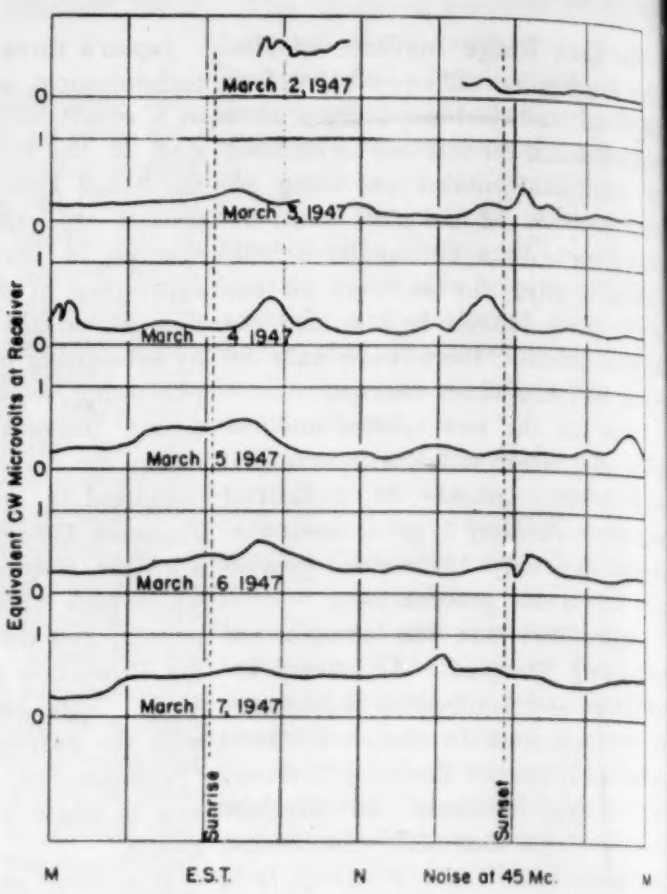

FIG. 1. M = midnight, N = noon.

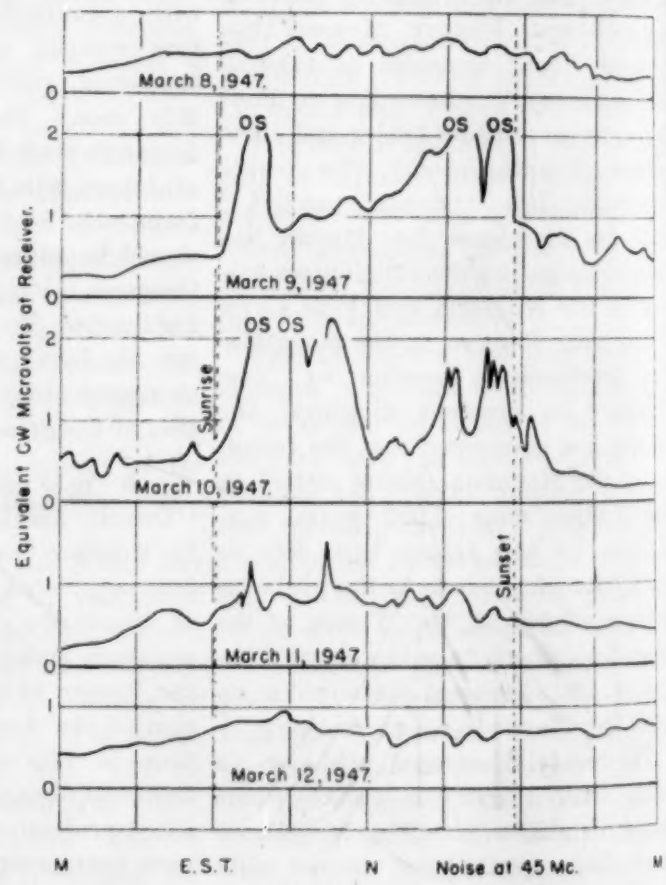

FIG. 2. M = midnight, N = noon, OS = off scale.

Tuning tests made during the occasion of the bursts indicated broad band emission.

The next occasion when conspicuous solar noise was recorded was on April 6, again with the appearance of a very large sunspot group. This was followed by a similar occurrence on April 15. In the interim, the sensitivity of the recording apparatus had been improved and at the same time the scale extended, thus avoiding any off-scale readings and making possible records of equivalent CW reception between 2 and 3 microvolts. A graphical exhibit of the burst of April 6, again at 45 mc, with the control records of April 5 and 7, is shown in Fig. 3.

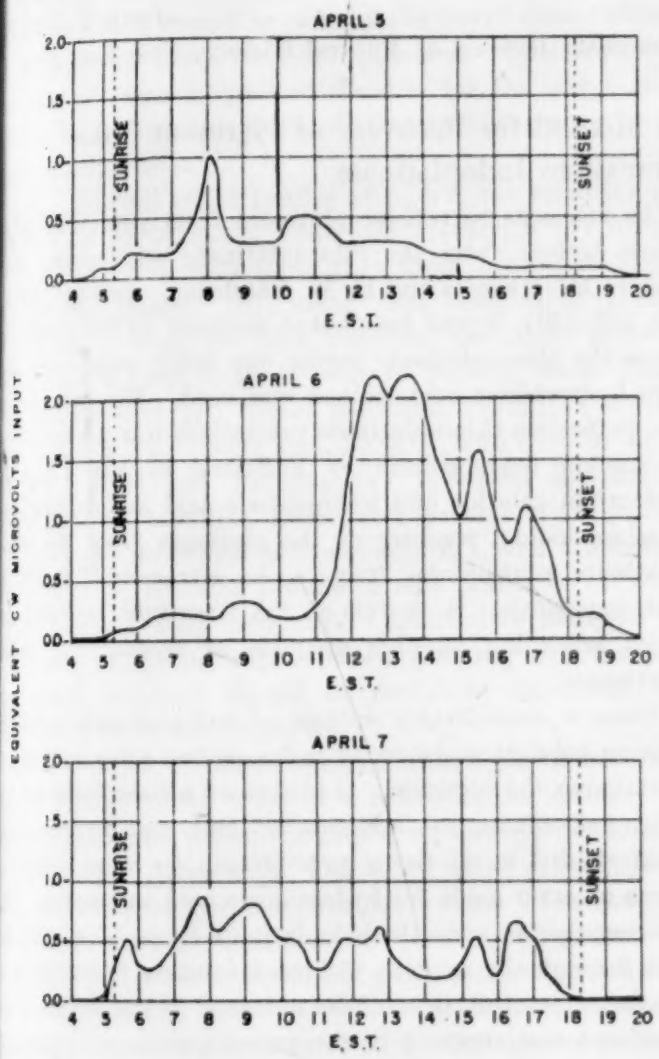

FIG. 3. Solar emission at 45 mc accompanying large sunspot of April 5–6–7, 1947.

With the return of the same active area on the sun early in May, noise bursts were again noted. On May 20, these were coincident with certain solar fade-outs on our recorders of WWV at 5-, 10-, and 15-mc frequencies. It had been anticipated that, with the continuation of solar activity, other bursts of comparable magnitude would be recorded. However, although the dipole and the recorder have since been in continuous operation, no bursts of such magnitude as those accompanying the sunspot of March 8 and 9 and of April 6 have been recorded.

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Beta-Glucuronidase

In conjunction with studies on beta-glucuronidase activity, interesting data were obtained from newborn infants. Infant cord blood was found to possess less beta-glucuronidase activity than maternal venous blood, thus confirming an earlier report (Donald F. McDonald and Lester D. Odell. *J. clin. Endocrinol.*, 1947, 7, 535–542). However, within 10 days the activity of infant venous blood (jugular puncture) had increased several fold. In fact, these levels were in excess of those found in normal pregnant patients near term. There was no differentiation as to sex, nor was breast feeding responsible. This observation may relate to the susceptibility of newborn infants to the formation of edema. It is known, for example, that pregnant women who develop preeclampsia, a syndrome associated with edema and difficulty in excreting NaCl, likewise exhibit an increased activity of beta-glucuronidase in the blood serum (Lester D. Odell and Donald F. McDonald. *Amer. J. Obstet. Gynec.*, July 1948).

BETA-GLUCURONIDASE ACTIVITY

Infant and Maternal Blood Serum

Identification	Maternal	Cord	Infant 10 days
260680	372	159	734
397239	466	204	921
296090	429	101	501
352844	367	283	379
422196	619	269	845
426787	408	39	945
392237	562	174	920

Infant Urine

Day of life										
0	1	2	3	4	5	6	7	8	9	10
8	111	555	155	670	157	232	136	74	525	845
28		520	1,000	182	84			93		703
9					577					298
2										
4										

(Single determinations on different infants.)

Amniotic Fluid

Identification	Maternal serum	Amniotic fluid	Infant urine*	Cord serum
392237	562	391	9	174
434537	530	157	2	

* Within 10 min of birth. Figures express gamma-phenolphthalein liberated/100 cc of serum or urine/hr. The method of analysis was that described by W. H. Fishman and B. Springer (to be published), which employs phenolphthalein glucuronide as substrate and which is an improvement over a previously reported method (P. Talahay, W. H. Fishman, and C. Huggins. *J. biol. Chem.*, 1946, **166**, 757–771).

The activity of beta-glucuronidase in infant urine was also of interest. At birth there was little activity, but this again increased during the first 10 days of life. There was no differentiation as to sex, nor was breast feeding responsible. The amniotic fluid was considerably higher in enzyme activity than the urine of newborns but less than maternal blood serum. Therefore, it is assumed that the beta-glucuronidase contained in amniotic fluid does not originate from fetal urine. Whether this

also implies that amniotic fluid originates from maternal rather than fetal sources is worth consideration. The probable influence of antiglucuronidase (inhibitor) (W. H. Fishman, K. J. Altman, and B. Springer. *Fed. Proc.*, 1948, 7, 154) on these changes is under investigation by one of us (W. H. F.).

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More About Ridgway's *Color standards and color nomenclature*

The account in *Science* (June 11, pp. 626–628) by Illman and Hamly on the unreliability of Ridgway's classic volume was very interesting. The authors seem not to have realized, however, that there is more than one edition of Ridgway's work. Some of the data they tabulate appear to concern copies of different editions and hence give somewhat false criteria by which to judge the imperfections of the book. The particular copy that they call the "good copy" is almost certainly one of the reprints, and perhaps others of the series examined are of the same sort.

Presumably because of the continuing demand for Ridgway's work, after the edition was exhausted, the printers of that volume undertook to reissue the work about 1937, using an undetermined number of leftover sheets and preparing new ones to fill the gaps—without the benefit of Ridgway's personal attention, since he had died some years previously. Still later, about 1940, an entirely new set of plates was projected, but whether they were issued or not I am unable to say. Unfortunately, no indication was given on the title page or in the letterpress that the new books were different from the originals, although there are minor distinctions that are apparent on comparison with an original, other than those found in the colors themselves. The colors in a great many cases are far from accurate counterparts of those of Ridgway's own preparation.

Of two original copies immediately available, one has been very little used, while the other has seen continuous service for the last 18 years. Although both show some spotting and discoloration—much more evident in the heavily used copy—the unaffected portions are identical in both or so nearly alike that a colored object matched in one set would find the same place in the other. On the other hand, a relatively new copy of the reissued work is decidedly different from the others. The differences, I am sure, are due not to deterioration of the older examples but to faulty preparation of the reissue.

I have no wish to criticize the *Mursell book of color* of which Illman and Hamly speak so highly. It is indeed a fine work, and one may hope that the pigments used in its preparation will prove to be more permanent than some of those available to Ridgway in 1912. I maintain, however, that Ridgway's *Color standards and color nomenclature* has not deteriorated so much and is not so useless as we are asked to believe. The problem is one of keeping references restricted to the original work, which I admit is difficult, since the printers have given no unequivocal clue to the reprints as they should have done. Whether the reprints are uniform among themselves also remains to be determined by someone with access to a number of copies. At any rate, they should not enter into a judgment of the original work.

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A Method for Recovery of Platinum From Potassium Iodoplatinate

In attempts to recover platinum from potassium solutions derived from the chloroplatinate colorimetric procedure (C. Hurwitz and H. W. Batchelor. *Soil Sci.*, 1947, 63, 351–359), it was found that recovery of the platinum from the chloroplatinate excess was fairly easy when the zinc-hydrochloric acid method was used. However, after the potassium chloroplatinate precipitate was converted to potassium iodoplatinate by buffering to pH 1.5 with potassium chloride and hydrochloric acid and adding potassium iodide, recovery of the platinum from the iodoplatinate solution was found to be extremely difficult, if not impossible. A search of the literature revealed no clues regarding possible methods of recovery of iodoplatinates.

Since a considerable volume of iodoplatinate solution was on hand, it was decided to try to find some method of reclaiming the platinum. Addition of a base followed by heat and subsequent addition of zinc and hydrochloric acid yielded no platinum precipitate, nor were substitutions of other acids for hydrochloric acid successful. Replacing the iodine in the iodoplatinate by passing chlorine gas through the solution yielded a solution from which a platinum precipitate could be obtained if the iodine were sublimed and removed in the gaseous state or separated out by filtration. However, this method of recovery would probably be as costly as the amount of platinum recovered and would be dangerous to the worker if there should be a chlorine leak. The iodoplatinate solution was found to yield a platinum precipitate upon addition of hydrochloric acid and zinc only if it had stood for a week or more before the zinc and acid were added. It was not found possible to do this with freshly developed potassium iodoplatinate. Further study of this problem is in progress.

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TECHNICAL PAPERS

Qualitative Analysis of Amino Acids in Pollen Collected by Bees[1]

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Pollen is collected by honeybees from a great variety of plants and is stored in cells of the brood comb, where it undergoes a lactic acid fermentation. This material provides an essential part of the diet for the larvae and adults, as it contains their only natural source of proteins and vitamins.

In an analysis of 34 species of pollen, the majority of which were bee collected, Todd and Bretherick (*5*) found the crude protein content to vary from 7.02 to 29.87%. Vivino and Palmer (*6*), using four samples of mixed pollen taken from the hive, reported the crude protein content on a fresh basis to average 20.15%, while Elser and Ganzsmüller (*3*) found the crude protein of *Pinus* spp. to be 12.5%; *Alnus* spp., 23.44%; and *Corylus* spp., 30.19%. Heyl and Hopkins (*4*) identified the amino acids arginine, histidine, lysine, and tyrosine in the pollen of ragweed (*Ambrosia artemisifolia* L.), and Anderson and Kulp (*1*) reported proline in corn pollen.

The present work comprises a qualitative analysis of the amino acids in a few pollen samples, and the information obtained should be useful in the study of the nutrition of the honeybee.

Pure samples of dandelion and willow pollen were removed from a brood comb of a colony in the spring. A sample of mixed pollen, largely composed of dandelion, willow, maple, plum, alder, and a few other plants which were unidentified was also obtained. From 0.1 to 0.2 gm of each sample was moistened with water and ground in a small mortar with powdered glass until many of the pollen grains had been crushed. The material was diluted approximately 1: 10 with 95% ethyl alcohol to precipitate the proteins, centrifuged, and the supernatant (extract) poured off. The extraction was repeated several times until the supernatant gave a negative ninhydrin test. The extracts were concentrated by evaporation almost to dryness and diluted to approximately 500 microliters with water. The free amino acids in these extracts were determined qualitatively by partition chromatography on filter paper according to the method described by Consden, Gordon, and Martin (*2*). Separation was accomplished on two-dimensional chromatograms, using 50 and 250 microliters of each extract.

The residue from the alcoholic extraction was analyzed qualitatively for the amino acids in the proteins. Half of the residue from each sample was hydrolyzed in 5 N NaOH and the remaining half in 5 N H_2SO_4. Hydrolysis was carried on for 10 hrs in small ampules in an autoclave at 120° C. The hydrolysates were then neutralized, extracted with 95% ethyl alcohol, and processed in the same manner as above. Aliquots of 50 microliters of each hydrolysate were used for the separation of the amino acids on two-dimensional chromatograms. Table 1 contains a list of the amino acids identified in the samples.

TABLE 1

Amino acids and amides	Dandelion		Willow		Pollen mixture	
	Free amino acids	Protein hydrolysate	Free amino acids	Protein hydrolysate	Free amino acids	Protein hydrolysate
Alanine	++	+	++	+	++	+
β-Alanine			+		+	
α-Amino-*n*-butyric acid			+	+	+	+
Arginine	+	+	+	+	+	+
Asparagine	+		++		+++	
Aspartic acid	+	+	+	+	+	+
Cystine		+		+	+	+
Glutamic acid		+	+	+	+	+
Glutamine	+		+		++	
Glycine	+	+	+	+	+	+
Histidine	++		+		+	
Hydroxyproline	+	+	+	+	+	+
Isoleucine and/or leucine	+	+	+	+	+	+
Lysine		+		+	+	+
Methionine	+	+	+	+	++	+
Proline	+++	+	++	+	+++	+
Serine	+	+	+	+	++	+
Threonine		+		+	+	+
Tryptophane			+		+	+
Tyrosine		+	+	+	+	+
Valine	+	+	+	+	+	+

(++) and (+++) indicate relative quantities of the compounds appearing on the same chromatogram.

The results indicate that pollen contains a large number of amino acids which varies somewhat with different pollen species. There are also variations in the same pollen species between the free amino acids and those which are constituents of the protein molecules. If the amides asparagine and glutamine are present in the proteins, they are converted to their respective amino acids during the hydrolysis and are therefore lacking in the hydrolysates. The presence of α-amino-*n*-butyric acid in two of the protein hydrolysates is not significant, since it is known that methionine may partially break down to that compound during hydrolysis. The separation of leucine from isoleucine is rather difficult when using collidine-lutidine as the second solvent; however, the evidence points strongly to the fact that both are present in the proteins of the three samples analyzed and as free amino acids in the pollen mixture. The two-dimensional

[1] Aided by a grant from the Lalor Foundation of Wilmington, Delaware.

chromatograms also contained a few unidentified spots, one of which may represent histamine, observed on the free amino acid chromatograms of the pollen mixture.

An analysis of pollen collected directly from dandelion plants gave the same results as those obtained from the dandelion collected in the beehive.

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The Formation of Monoiodotyrosine From Radioiodine in the Thyroid of Rat and Man[1]

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A further investigation of the multiplicity of radioactive substances found in filter paper chromatograms of thyroid hydrolysates (*1*) has indicated that monoiodotyrosine acts in the metabolism of iodine by the thyroid.

Ten rats were given an intravenous or intraperitoneal injection of 0.05–1 mc of carrier-free I^{131} and sacrificed from 1 min to 10 days later. The thyroids received from about 0.5 to 40,000 rep (roentgen equivalents, physical) of beta radiation, delivered at rates varying from about 30 to 10,000 rep/hr. Portions of the thyroids were hydrolyzed in sealed tubes at 100° C with 8% $Ba(OH)_2 \cdot 8H_2O$ for 6 hrs, 2N NaOH for 10 hrs, or 6N HCl for 24 hrs. The hydrochloric acid hydrolysate was evaporated as a small spot directly on a sheet of filter paper. The sodium hydroxide hydrolysate was adjusted to approximately pH 4 with 6N H_2SO_4, and a butyl alcohol extract of this solution was applied to the paper. The $Ba(OH)_2$ hydrolysate was adjusted to approximately pH 8 with 6N H_2SO_4, centrifuged, and the supernatant used for preparing the chromatogram.

Two-dimensional chromatograms were developed at 26° C with phenol as the first solvent and the upper phase from a secondary butyl alcohol, tertiary butyl alcohol, and water mixture (4, 1, and 4½ vols, respectively) as the second solvent. After the phenol run, the paper was washed with methyl alcohol except for a narrow strip below the original spot.

Radioautographs were prepared to show the exact positions of radioactive substances, the corresponding portions of the filter paper cut out for Geiger counter measurements, and the chromatograms then sprayed with ninhydrin. In each of the 40 chromatograms prepared as outlined a highly radioactive spot appeared with R_F values between those of tyrosine and diiodotyrosine. When monoiodotyrosine[2] was added either before hydrolysis or directly to the filter paper, it gave a ninhydrin spot which corresponded exactly both in *position* and *shape* with that of the above-mentioned radioactive spot.[3] The total radioactivity in the monoiodotyrosine spot ranged from about one-third to two-thirds of that shown by the adjacent diiodotyrosine spot.

A chromatogram was prepared from a $Ba(OH)_2$ hydrolysate of a thyroid biopsy specimen taken from a patient with an adenoma of the thyroid 8 days after the oral administration of 12 mc of I^{131} (*5*). It likewise showed a radioactive spot corresponding to monoiodotyrosine and containing about half the amount of radioactivity present in the diiodotyrosine spot.

As a check on the possibility that radioactive monoiodotyrosine might have been formed by exchange with or decomposition of, other iodine-containing substances of the thyroid during the processing of the tissue, normal rat thyroids were hydrolyzed with 2N NaOH in the presence of carrier-free I^{131} or in the presence of various radioactive substances isolated from chromatograms. Radioiodide under these conditions gave a chromatogram similar to those obtained when iodide is chromatographed alone, mono- and diiodotyrosine yielded small amounts of iodide, and about 10% of the thyroxine broke down to diiodotyrosine and iodide. A mixture of two or more radioactive compounds with R_F values between those of diiodotyrosine and thyroxine yielded small amounts of iodide, monoiodotyrosine, and diiodotyrosine. The relatively slight amount of radioactivity associated with monoiodotyrosine in these control studies, in contrast to the *in vivo* findings described above, strongly indicates that the compound was present before the processing of the tissue. The possibility remains, however, that iodine-containing amino acids bound in their normal peptide linkage may be more subject to decomposition than were the free amino acids used as markers in these control experiments. This question is under investigation.

Considering the large amount of radioactivity associated with the monoiodotyrosine spot after administration of radioiodine and the reportedly low concentration of this compound in thyroglobulin (*4*), it seems probable that monoiodotyrosine attains a high specific activity. Preliminary tests indicate that by use of radioactive reagents it may be possible to determine the concentration of a number of the iodine-containing compounds on an

[1] Published with permission of the chief medical director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the authors.

[2] The authors are indebted to S. Woislawski for preparing a supply of 3-iodotyrosine according to the method of Harington (*2*) and to C. E. Dent for sharing a sample of the compound given to him by C. R. Harington.

[3] From the data available there seems little doubt that the substance in question actually is monoiodotyrosine, but it is hoped that additional evidence may be obtained by means of the electron diffraction pattern (*3*) when the installation of an electron microscope at this laboratory is completed.

tramicro scale and thus obtain data on specific activities studies of the type described here.

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Some Factors Involved in Oxygen Evolution From Triturated Spinach Leaves

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Now that a technique has become available for studying quantitatively the evolution of oxygen by isolated chloroplasts and by fragments of chloroplasts, it is possible to determine some of the factors involved in the reactions. Hill (*5*) made the first advance toward quantitative measurements of oxygen produced by isolated chloroplasts, and Warburg and Lüttgens (*7*) simplified the procedure by using a single substance, *p*-benzoquinone, as the hydrogen acceptor in place of the complex mixture employed by Hill (*6*). Warburg and Lüttgens also demonstrated that pieces of chloroplasts 0.5 μ in diameter were just as efficient as intact chloroplasts in the photochemical yield of oxygen. That other types of quinones could be used as the oxidant was shown by Aronoff (*1*), the rate of oxygen production being roughly proportional to the redox potential of the quinone.

Young spinach leaves were ground in the Waring blendor for 2 min in a solution of M/20 phosphate buffer of pH 6.9, using 5 ml of buffer/gm fresh weight of tissue. This triturate was then filtered twice through glass wool and centrifuged for 20 min at 3,000 times gravity. The clear, yellowish-green supernatant was the "suspension" used in all experiments carried out in the Warburg manometric apparatus containing an atmosphere of purified nitrogen. Illumination of 2,000 foot-candles was provided by 9 fluorescent lamps mounted below a glass-bottomed water bath designed and built by G. F. Somers, of the Federal Nutrition Laboratory at Cornell University. All experiments were performed at 25° C.

Repeated microscopic examination under the oil immersion lens (magnification, 1,000×) failed to disclose any particles in the suspensions within the visible range, thus indicating that the active material from the leaves was in colloidal solution. Further evidence for this conclusion was provided by centrifuging the supernatant solution in a Beams air-driven ultracentrifuge at an estimated relative centrifugal force of 400,000 times gravity. No sedimentation of the material occurred when centrifuged for periods sufficiently long to bring down any of the larger particles. That the chlorophyll was firmly adsorbed or chemically combined with protein was revealed by dialysis, ultracentrifugation, and "salting out" procedures much the same as those employed by numerous other workers. Evidence that one or more of the constituents of the material here described is enzymatic in nature was furnished by the behavior toward heat and heavy metals. As little as 0.1 ppm of copper completely inactivated the suspensions.

The cell-free and chloroplast-free suspensions evolved more oxygen under identical experimental conditions than did small pieces of intact leaves, ground leaf tissue, or whole chloroplasts—an observation which has already been made by Aronoff (*2*). Calculated on the basis of oxygen produced by intact leaf tissue, the whole chloroplasts produced approximately 100% more oxygen and the suspension of triturated material 150% more oxygen over a period of 30 min of illumination. A plausible explanation of this difference in activity between various tissue fractions might be based on the lower permeability of the intact cells or chloroplasts to the reactants.

Use of higher concentrations of *p*-benzoquinone than the 2 mg/2 ml of solution employed by Warburg and Lüttgens enhanced the rate of oxygen evolution. Doubling the amount of quinone to 4 mg/2 ml of suspension increased the rate by 35%, and quadrupling the concentration caused a 60% increase in rate. Some of the quinone is probably lost in side reactions.

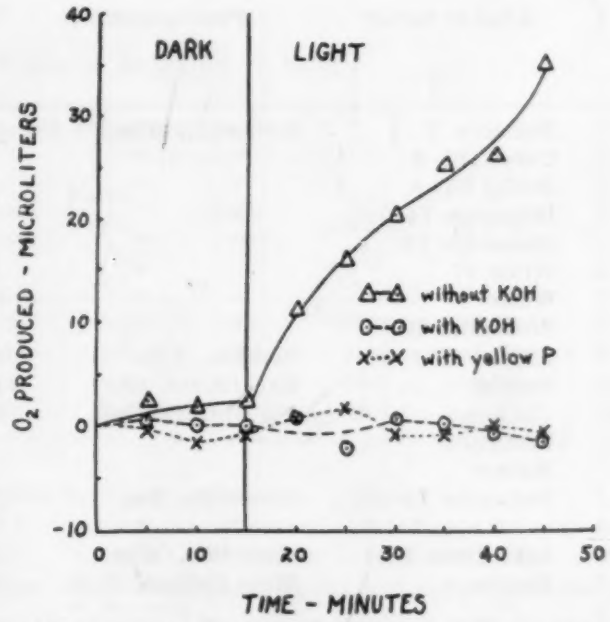

FIG. 1. Necessity of CO_2 for oxygen evolution.

One of the most significant observations to come out of this work was the apparent necessity of minute quantities of CO_2 to bring about oxygen evolution. When commercial nitrogen was purified for use in the manometers and vessels and when 0.1 ml of 10% KOH was placed in the center well of the vessels to take up CO_2, the pressure change remained near zero, but when the KOH was left out, considerable gas pressure developed. The pressure developed in the manometers without KOH could not have been due to evolution of CO_2 because, when yellow phosphorus was placed in the side arm of a

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vessel to absorb O_2, the changes over the same period of time varied around zero. The results of one such experiment are shown in Fig. 1.

It is tempting to speculate that the water-soluble, heat-stable factor mentioned by French in his review of photosynthesis (*4*) is carbon dioxide or some substance readily produced from carbon dioxide by plant cells or cell constituents. If such a situation is subsequently found to be of general occurrence in plant materials, it would provide a link between photosynthesis and the type of organic acid metabolism recently reviewed and studied by Bonn and Bonner (*3*).

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The Organic Acid Content of Various Samples of Raw Cotton Fiber in Relation to Ash Alkalinity and Leaching by Rain

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Raw cotton fiber contains *l*-malic acid, citric acid, and unidentified organic acids (*3*). A number of samples of raw cotton fiber of different varieties and grown in different places were analyzed in order to obtain information on variation in organic acid content.

Citric acid, *l*-malic acid, and total organic acids, exclusive of pectic acid, were determined by the methods of Pucher, Wakeman, and Vickery (*4*) after fuming the samples with hydrochloric acid and extracting with ether (*2*). Pectic acid was determined by the method of Whistler, Martin, and Harris (*5*), the values being calculated in milliequivalents, directly from the carbon dioxide values. The methods of Fargher and Probert (*2*) were used to determine ash and ash alkalinity. Moisture

TABLE 1

Organic Acids, Ash, and Ash Alkalinity of a Number of Samples of Raw Cotton Fiber

No.	Kind or variety	Place grown	Year	Milliequivalents/100 gm of dry cotton				Ash % M.F.B.	pH of water extract
				l-Malic acid	Citric acid	Total* organic acid	Ash alkalinity		
1	Bobshaw 1	Stoneville, Miss.	1945	2.8	0.7	9.5	14.2	0.97	7.5
2	Coker 100–9	" "	"	2.8	0.6	7.6	15.1	0.97	7.7
3	Delfos 531–C	" "	"	3.1	0.7	8.0	14.4	0.97	7.5
4	Deltapine 14–060	" "	"	3.4	0.7	7.8	13.1	0.89	7.3
5	Stoneville 2B	" "	"	3.2	0.7	7.9	14.8	1.00	7.5
6	Wilds 17	" "	"	2.8	0.8	7.8	15.6	1.06	7.8
7	Wilds	" "	1943	8.5	1.5	13.7	20.5	1.31	6.2
8	Stoneville 2B	" "	"	6.9	1.1	12.1	17.0	1.07	6.4
9	SXP	Sacaton, Ariz.	1942	4.7	0.8	11.6	16.7	1.06	6.5
10	Empire	Experiment, Ga.	1944	2.8	0.7	8.2	14.0	0.86	7.2
11	Unknown	Big Springs, Tex.	1941	7.2	0.9	12.8	16.5	1.16	6.5
12	Immature	....	..	6.1	1.5	14.6	21.8	1.32	5.8
13	Mature	....	..	1.7	0.6	5.7	11.7	0.79	7.6
14	Deltapine 14–060	Greenville, Tex.	1945†	7.1	0.8	11.5	15.4	1.02	6.3
15	" " "	" "	1945‡	9.5	1.0	14.0	17.0	1.07	6.2
16	Ark. Green Lint	Stoneville, Miss.	1942	2.5	1.1	10.7	15.4	1.07	6.5
17	Empire	State College, N. M.	1945	5.6	1.2	12.2	17.1	1.15	6.5
18	"	" " " "	"	6.9	1.0	11.6	16.5	1.12	6.4
19	Deltapine 14	" " " "	"	10.3	0.7	16.1	20.2	1.32	6.4
20	" "	Rocky Mt., N. C.	"	3.7	0.7	9.4	13.2	0.90	6.8
21	Stoneville 2B	" " " "	"	4.1	0.8	9.5	14.7	1.01	7.0
22	Coker 100–8	" " " "	"	4.9	0.9	10.5	15.7	1.00	6.9

* Not including pectic acid.
† Early-opening bolls.
‡ Late-opening bolls.

[1] We wish to thank J. W. Neely, A. R. Leding, P. H. Kime, D. R. Hooton, Thomas Kerr, and R. H. Tilley, of the Bureau of Plant Industry, Soils, and Agricultural Engineering, for supplying samples of cotton fiber.

[2] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration.

values, for calculating to the dry-weight basis, were found by drying in a forced draft oven for 5 hrs at 105° C. The pH of the water extracts was determined by adding 5 ml of hot water to 0.5 gm of ground cotton fiber in a test tube, mixing with a rod to wet the cotton, heating

a water bath for 1 hr, cooling, and measuring the pH the supernatant liquid with a glass electrode.

The data in Table 1 show that raw cotton fiber varies greatly in organic acid content. The greatest variation

TABLE 2

RELATIONSHIP BETWEEN ASH ALKALINITY OF RAW COTTON AND THE SUM OF THE PECTIC AND OTHER ORGANIC ACIDS

Sample No.	Milliequivalents/100 gm of dry cotton: Pectic acid A	Other organic acids B	Sum A + B	Ash alkalinity	pH of water extract
5	4.8	7.9	12.7	14.8	7.5
6	4.9	7.8	12.7	15.6	7.8
7	6.9	13.7	20.6	20.5	6.2
8	4.9	12.1	17.0	17.0	6.4
10	5.6	8.2	13.8	14.0	7.2
11	4.7	12.8	17.5	16.5	6.5
12	7.0	14.6	21.6	21.8	5.8
13	3.2	5.7	8.9	11.7	7.6
17	5.5	12.2	17.7	17.1	6.5
20	4.3	9.4	13.7	13.2	6.8

shown by *l*-malic acid, while citric acid and the unidentified portion of the organic acids, which may be obtained by difference, show less variation. The first 6 samples listed, all of which were grown in the same place and at the same time, show little variation, although they are of different varieties. Some of the same varieties, grown at different times or in different places, showed large differences in organic acid content. It appears that some environmental factor was more important than variety in controlling the organic acid content. The data also show a rough correlation between the content of organic acids and the ash and ash alkalinity. This is not surprising, since the organic acids occur in the fiber as salts.

It seemed likely that better correlation between organic acid content and ash alkalinity would be obtained by taking pectic acid into consideration. Pectic acid was therefore determined on 10 selected samples. From the results given in Table 2 it will be seen that the agreement between the total organic acids, including pectic acid, and the ash alkalinity is rather good. Where the ash alkalinity exceeds the sum of the acids, the pH of the water extract is high. The quantity of acid necessary to change 100 gm of raw cotton fiber from pH 7.5 to pH 6.5 was found to be about 1.3 milliequivalents. If this value is used to correct to the same pH, the agreement is even better.

Since the potassium and sodium salts of *l*-malic and citric acids are water soluble, it seemed probable that leaching of the fiber by rain would have a large effect on the organic acid content. Samples were collected from tagged bolls before and after rain by R. H. Tilley, of the Bureau of Plant Industry, Soils, and Agricultural Engineering at Statesville, North Carolina. Cracked bolls were tagged on September 26 and a sample dried in a greenhouse. The second sample, collected from the field on October 2, was definitely dry and untouched by rain. From October 7 to 10 there was a 4-day rain. The third sample was collected on October 13, and the last sample on October 20, some rain having fallen in the interim. Because of the small size of these samples, pectic acid was determined by an unpublished colorimetric method based on a reaction described by Dische (*1*). The data given in Table 3 show that rain and other weathering factors have a profound effect on the organic acid content of raw cotton fiber, especially on the *l*-malic acid content. The high pH of the fiber exposed to rain is of interest. Microorganisms in the wet cotton and surviving metabolic processes as well as leaching may be factors in the action of rain on the organic acids.

TABLE 3

ORGANIC ACID CONTENT OF RAW COTTON FIBER IN RELATION TO RAIN

No.	Description	Milliequivalents per 100 gm dry cotton: *l*-Malic acid	Citric acid	Total * organic acids A	Pectic † acid B	Sum A + B	Ash alkalinity	Ash % M.F.B.	pH of water extract
23	Dried in greenhouse, no rain	15.4	1.1	20.3	5.1	25.4	23.2	1.50	6.2
24	Remained in field, no rain	12.2	1.2	15.9	5.0	20.9	19.4	1.22	6.4
25	Same after 1 heavy rain (2.6 in)	3.7	0.5	7.4	3.9	11.3	15.2	0.98	8.6
26	Same after 3 more rains (0.6 in)	2.3	0.3	6.3	3.5	9.8	14.3	0.94	9.0

* Not including pectic acid.

† Determined by a colorimetric method based on a reaction described by Dische (*1*).

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IN THE LABORATORY

Determination of Exposure Time in Color Photomicrography

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The determination of exposure time in color photomicrography is a problem which is of utmost importance to the microscopist. The technique of "trial-and-error" exposure, which is almost universally used and recommended, has serious drawbacks. This method is time consuming and inexact, since the criterion of good exposure is determined by the subjective discrimination of the particular worker, and the exposure times are not of wide applicability, necessitating test exposures for different slides and stains. The method of choice would be one in which the criterion of a proper exposure is objectively and accurately determined, and one which can be used for a wide range of microscopic preparations.

The procedure devised employs an electronic photometer[1] to measure the intensity of the light, Wratten filters number 55 (green) and 38A (blue), and an "Omag" R-I (red) filter, to calibrate the instrument. The scale of the photometer is graduated from 0 to 100% transmission and can be used as an arbitrary measure of the light intensity in the microscopic field. The technique involves the calibration of the instrument for exposure time at various light intensities, using physical methods, all of which are available to the average laboratory.

In order to calibrate the photometer scale, a filtered light source is set up, using one of the filters and a number 2 photoflood lamp. The 4-mm objective is set at the distance from the stage that it would be were it focused on a microscopic slide. A 35-mm camera adapter is set into the body tube of the microscope, and a series of at least three test exposures are taken of the colored field for each light intensity. The light intensity, which is measured with the photometer "seeker" placed in the adapter with the camera removed, can be varied by manipulating the iris diaphragm of the substage condenser. This procedure is repeated with each of the above-mentioned filters at specific light intensities.

Qualitative inspection of the processed transparencies will show that they run in a series. For a given intensity, one transparency will be underexposed, one will be overexposed, and an intermediate transparency between the two former will seem to be properly exposed when compared with the filter used.

[1] The instrument used was a model 500 electronic photometer manufactured by the Photovolt Corporation, New York City.

The criterion of the proper exposure is not the actual color of the transparency but its percentage transmission of white light as compared with the original filter. We have found that the shapes of the spectral transmission curves are essentially the same, and the wave length which permitted maximal transmission is about the same, regardless of the over- or underexposure of the transparency. The variable, then, which serves to define the best exposure is the percentage transmission of a beam of light passed through the transparencies. This can be measured using the same photometer which is being calibrated. The apparatus measures per cent transmission directly from the photometer scale, and the transmittance of the filters and the test transparencies are determined. The proper exposure for a given filter (and hence for a given spectral range) at a given light intensity will be that exposure given to the test transparency which has a transmittance most similar to that of the filter used.

A sample series of the calibration data is presented in Table 1.

TABLE 1

Intensity reading	Exposure (sec)	Transmission of transparency (%)
70	1/5	31.1
70	2/5	35.0
70	4/5	38.2*
Transmittance of "Omag" R–I (red) with neutral film base		40.0

* Indicates best exposure time.

TABLE 2

Intensity reading	Exposure time (sec)			
	Red or Blue		Green	
	t	1/t	t	1/t
25	2.24	0.44	1.12	0.89
35	1.60	0.63	0.80	1.25
50	1.12	0.89	0.56	1.78
70	0.80	1.25	0.40	2.50
100	0.56	1.78	0.28	3.57

If the data in Table 2 are represented graphically, as in Fig. 1, a straight-line curve in the form

$$I = K \cdot (1/t)$$

results, I being the intensity of illumination (densitometer reading); t, the exposure time in seconds to produce a satisfactory transparency; and K, a constant. This equation is of the same form as the Bunsen-Roscoe reciprocity law and indicates that the exposure times are based on sound physical principles (*1*, *2*).

In a test series of photomicrographs of histological material, transparencies of excellent color rendition and density were produced, and the percentage of improper exposures was reduced to zero.

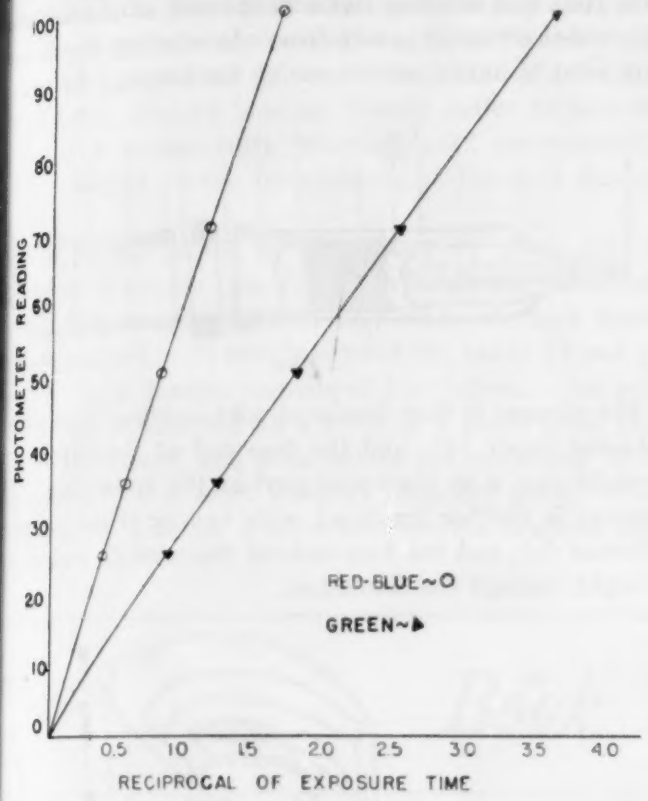

FIG. 1

This physical, nonsubjective method of exposure time determination in color photomicrography can be routinely used over a wide range of biological material.

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A Simple Electronic Electrolytic Drop Recorder

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The majority of drop recorders or drop counters in use today for the measurement of salivary secretion, urine output, and bile flow are of two fundamental types (*2*). One, the electromechanical type, which is available commercially, allows the drop to overbalance a bucket-ended lever, which in turn makes an electrical contact. With careful adjustment and continuous supervision, these drop recorders can be made to work satisfactorily with thin, watery fluids, like urine, but viscous secretions tend to stick to the bucket so that the system does not return to normal for ensuing drops. The other system is far more satisfactory. The drop serves to make contact between two electrodes, and a sensitive relay serves to actuate a writing lever (*1, 4, 5*). However, the very sensitive relays needed are liable to stick, and the high voltage requirement is hazardous. The current needed for more rugged relays corrodes ordinary electrodes rapidly so that they are soon inoperable.

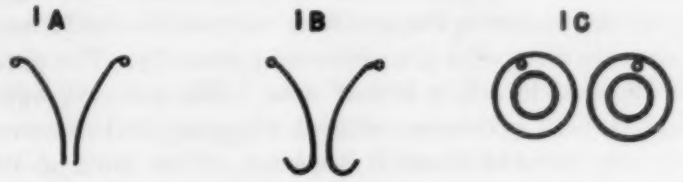

FIG. 1

These undesirable attributes may be easily overcome by proper electrode design and by using an electronic relay between the electrodes and an ordinary "physiological signal magnet" or one of the more elaborate integrating signal magnets (*6*). Biskind and Dan (*1*) suggested the use of curved platinum-wire electrodes (Fig. 1a) that would catch a drop, even though the drop source was not accurately centered, and yet not hold the drop after momentary contact was made. We have had excellent success with similar electrodes made of nichrome wire (Fig. 1b), but they are too frail for general student use. At present we are using stainless-steel washers (Fig. 1c). The eccentric hole facilitates adjustment to any desired size gap. The electrodes are attached to Johnson stand-off insulators with 6–32 hex nuts, although thumbscrews could be used. By placing a medicine dropper orifice at sufficient height above these electrodes, a drop of even a very viscous fluid will have enough velocity to fall through the electrodes without sticking after making momentary contact.

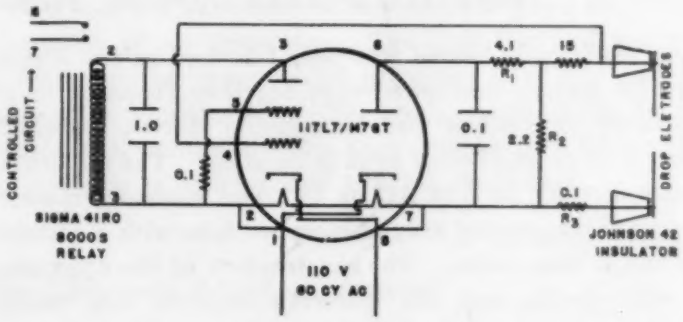

FIG. 2. All resistances in megohms; all resistors, ½-watt size; all condensers in microfarads; all condensers, 200-v paper type.

Although there are several hard-tube electronic relays on the market at present, we found it convenient to design our own device, which has certain advantages in that it is sturdy, simple, economical, and dependable. The wiring diagram in Fig. 2 is self-explanatory. The 117L7/M7GT electronic tube was used, since it combines both rectifier and tetrode in one envelope and requires no filament resistor or transformer. A 117N7 or 117P7 could be used with appropriate socket changes. The Sigma relay[1] was used because it has adequate sensitivity

[1] Sigma Instrument Company, 70 Ceylon Street, Boston, Massachusetts.

at low cost and is also hermetically sealed against dust and moisture. Being of the plug-in type, it can be easily replaced if necessary. In an early model, a variable resistor ("volume control") was used in place of R_1–R_2, but this was found unnecessary, since the present unit will operate if any resistance between 0 and 20 megohms connects the electrodes. The 0.1 megohm resistor, R_3, is introduced to lower the available current to a safe level in case the electrodes are contacted personally. The parts are mounted in a $2'' \times 4'' \times 4''$ case. The unit will operate up to 15 cycles/sec without skipping, but we were only able to make about 7 drops/sec. This limit of 420 drops/min is in good agreement with the elegant photoelectric device of Josten (*3*). Three of these units have been in use during the past two years with no adjustments or repairs being necessary. The cost, exclusive of labor, is less than one-fourth that of commercial units.

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Electrically Heated Wax Pencil for Sealing Inoculated Eggs

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An electrically heated wax pencil devised in our laboratory for sealing inoculated eggs has been found to be an extremely convenient and time-saving device, especially when a large number of eggs is handled. The apparatus works directly on 110 AC or DC, and basically consists of an element wound around a copper tube with a suitable tip and release valve. The construction of the apparatus is very simple, and the materials required are readily available.

With the following on hand the apparatus could be easily constructed in any laboratory: (1) Spencer immersion oil dropper (Catalogue #470, Spencer Lens Company); (2) brass or copper tube, with an internal diameter of $\frac{5}{16}''$ and 4″ or 5″ in length; (3) 20′ of nichrome wire, gage 32, with a resistance of 10 ohms/ft; (4) asbestos paper; (5) a piece of steel or brass rod, $\frac{1}{16}''$ in diameter and 7″ long.

The cap of the immersion oil dropper is removed, and one end of the copper tube is fitted in its place. The joint so formed is soldered to make it leakproof. Next, one layer of asbestos paper, which has been moistened to prevent it from cracking, is wrapped tightly over the tube and part of the dropper (a, Fig. 1), leaving approximately 1″ of the tip of the dropper and ½″ or so of the free end of the tube exposed. While the asbestos paper is still wet, approximately 20′ of nichrome wire is closely wound around the insulated portion of the apparatus, starting from the upper end of the tube (b), leaving 1″ of the wire free, and winding down to the end of the insulation (c), where 4″ or 5″ is left free. In winding the element care must be taken not to overlap the loops of the wire.

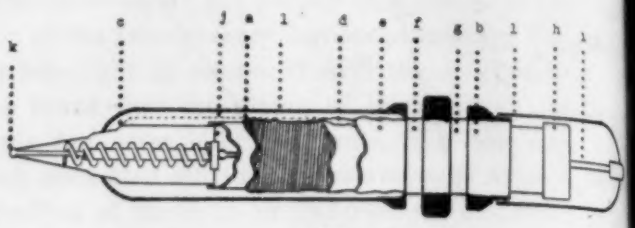

Fig. 1

The element is then insulated with another layer of wet asbestos paper (d), and the free end of the wire (e) is brought over it to the upper part of the apparatus. The element is further insulated with two or three layers of asbestos (e), and the free ends of the wire (b and e) are brought through the insulation.

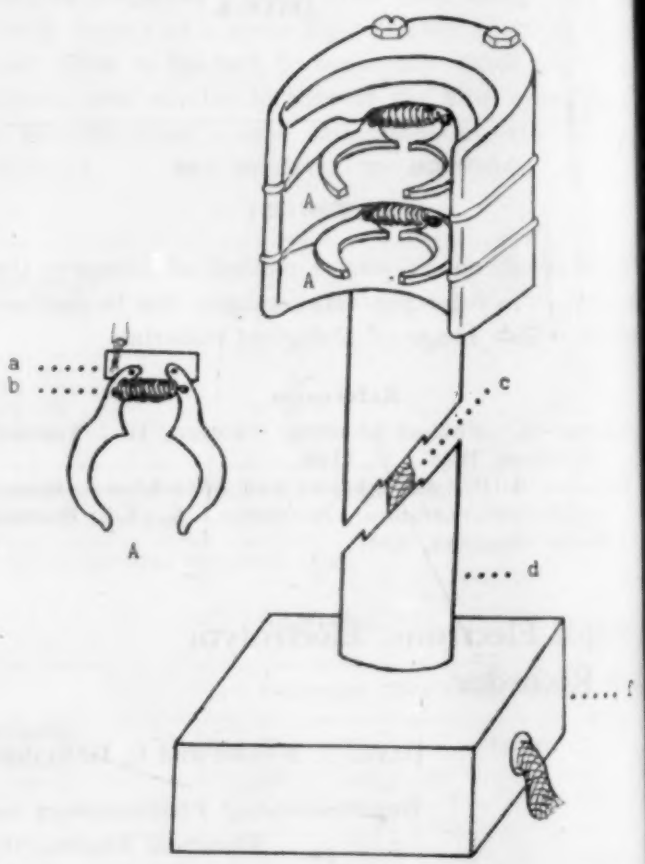

Fig. 2

The free end of the wire (e) is soldered to a narrow ($\frac{3}{16}''$ wide) copper strip, and the latter is tightly wound around the insulation, having the soldered wire on the inside, and soldered to form a band (f). The second free end of the wire is soldered to another similar copper strip, and in the same manner the second contact band (g) is made. The bands are spaced about ½″ apart.

The apparatus is then embedded in acrylic (l) or wrapped into one or two thin layers of cork, leaving the contact bands exposed.

The free end of the copper tube is covered with a tightly fitting cap (h) with a central hole. The cap can

made easily from a piece of copper, with the aid of a dering iron. A plunger (i) approximately $\frac{1}{16}$" in meter, which is inserted through the cap hole, should of such a length that one end of it rests on the release re (j) and the other protrudes above the cap (h).

For simplicity of construction, an electric cord could attached permanently to the bands (f and g), the apratus being plugged into an electric outlet as needed. found a permanently attached cord inconvenient, wever, because of the interference of the cord during ration.

The apparatus in use in our laboratory plugs into a nd made of acrylic (see Fig. 2) in which are embedded pairs of contact brackets (A) made of thick brass te and shaped to fit snugly around the bands (f and g, , 1). Each bracket consists of two halves. One end each half is attached on a pivot to a small plate (a) ich is stationary, and both halves are connected by a ll spring (b) a short distance from the plate. The ing ensures a better contact between the brackets and the bands and also keeps the apparatus in place when it is plugged in. The bracket plates are connected to an electric cord. The cord (c) passes through a metal tube (d), which serves as the stem of the stand, and through the back of the base (f) and is connected to an electric plug. The base is made of plaster of Paris.

The brackets could be embedded between layers of Bakelite or some other insulating material, instead of acrylic.

The pencil is filled with melted paraffin through the free end of the copper tube after removing the cap (h). The capacity of the pencil of these dimensions is about 20 cc.

Before using, the pencil is plugged in for 2 or 3 min, which time is sufficient to melt the paraffin inside. Then, by pressing with the finger on the plunger, a drop is released through the opening (k, Fig. 1). The paraffin remains liquid for approximately 10 min, thus enabling an operator to seal a considerable number of inoculated eggs with a single heating.

Book Reviews

mparative physiology. Bradley T. Scheer. New York: John Wiley; London: Chapman & Hall, 1948. Pp. x+563. (Illustrated.) $6.00.

While this useful textbook may be considered as a riation of the general physiology type, it was written m a somewhat different approach. The title empha- es the fact that the objective is comparative physi- gy, and the treatment is more on a phylogenetic basis. order to fulfill the difficult task of distinguishing alogy of function from homology of function, the thor considered it necessary "to compare functions in ganisms which are reasonably closely related." The apters in the book, therefore, are divided not accord- to organ or functional systems but according to yla. In the treatment of each major phylum as a it, an attempt is made to trace evolution of function that unit. In each chapter there is also a concluding mmary which discusses the relations of the phylum nsidered with other phyla. It may be added that the rtebrates receive a good third of the total space de- ted to all the major phyla.

Since the comparative method is emphasized through- t the book, the author utilizes the first chapter (56 pp.) r a general statement. This should be particularly lpful to the student. In this chapter are summarized e general physiological processes common to most ani- als. A good portion of the chapter is devoted to me- bolism and nutrition, particularly carbohydrate me- bolism. The succeeding chapters are "concerned with e deviations from the picture—and with the elaboration new processes to meet particular circumstances."

A good deal of the material and fairly extensive references have been brought up to date. An increase in the number of illustrations and an author index would add to the usefulness of the book to the student. In addition to a subject index there is one of species mentioned in the text and an appendix of classification of animals.

This is not a handbook of comparative physiology but a textbook of moderate size. The objective and method of this type of comparative physiology, as the author states, are analogous to the fundamental methods of comparative anatomy. The book should thus be useful for students in zoology and general physiology.

SAMUEL GELFAN

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Astronomy: a textbook for colleges. William Lee Kennon. Boston: Ginn, 1948. Pp. vii + 737. (Illustrated.) $5.50.

With the appearance of this volume, another member has been added to the group of elementary college astronomy textbooks. The author has been professor of physics and astronomy at the University of Mississippi since 1911, and this is the outgrowth of his long teaching experience. The book is characterized mainly by the simple and explicit style in which it is written. It is also extensively illustrated with pictures, astronomical photographs, and drawings. The author emphasizes that he has tried to "preserve the sequence of observation, application, and interpretation." This produces a somewhat disjointed result, because the same subject matter is treated in

more than one place. But the author has spared no effort to maintain the student's interest.

The book is marred by a number of minor errors and defects which should not have been permitted to occur. For example, Fig. 3.6 employs the poor choice of notation, α for altitude and λ for latitude, and then mislabels the complement of α for α. Fig. 16.9 illustrates the diameter of Mars and the orbits of its satellites to scale, but the text states, "diameter of the orbit of Mars." On page 306 the expression for the Fitzgerald contraction contains a + sign instead of a – sign under the radical. On the date of the Siberian meteor shower of 1908, the earth is said to be within 0.03 a.u. of the comet, instead of the orbit of the comet. Such blunders are confusing to the beginning student, who has not yet enough background to be discerning.

No mention is made of the splendid pioneering meteor researches of Whipple, but the work is attributed to "the Blue Hills Meteorological Observatory (connected with Harvard University)." On page 233 there is a confused statement concerning the "Trogan Group." Adonis is omitted from the list of minor planets approaching very close to the earth. The brilliant success of Struve and his associates in explaining the observed phenomena of β Lyrae is not even mentioned.

The reviewer would make one other criticism of a general nature. The number of pages allotted to each of the various topics from classical Newtonian gravitational astronomy down to the most recent astrophysical developments is apportioned so as to give a prospectus of the whole field of astronomy that was valid about a quarter of a century ago. It is high time for a textbook of this kind to appear which presents the current status of astronomy in its true light, with the theoretical developments and interpretations of observations during the last three decades about on a par with that of the preceding three centuries.

PAUL HERGET

The Cincinnati Observatory

Synthetische Methoden der organischen Chemie. (Vol. II.) W. Theilheimer. Basel, Switzerland: S. Karger, 1948. Pp. viii + 309. Sfr. 35.

Volume 2 of *Synthetische Methoden* follows the plan of the first volume. It presents brief directions for organic syntheses and degradations arranged in an original, formal system wherein reactions are grouped according to the new bonds that are formed and with no consideration of the mechanism or intermediate stages involved. The literature of 1945–46 is covered with the exception of American periodicals, which will be taken up in a forthcoming issue.

Any discussion of Theilheimer inevitably brings up the merits of the coded arrangement. In the opinion of the reviewer, it is simple, reasonable, and well worth the short time necessary to master it. For example, if one should wish to find information on the amination of a pyridine nucleus, through the code he could find it in a moment under the entry NC ⇵ H, which groups those reactions in which a carbon-nitrogen bond is formed by replacement of hydrogen. Consultation of the generous alphabetical index, on the other hand, reveals a profusion of references under "amines" and "amino-," not one of which leads immediately to the right reference. Furthermore, it cannot be located as a named reaction unless one recalls that the eponymic *Chichibabin* appears in a German index under the T's. The code, however, is not infallible, for placements are occasionally arbitrary, and it is fair to say that the alphabetical index will suffice in a large proportion of cases.

This book has a place in the library of the organic chemist who is concerned mainly with synthesis. In addition to classical material, it contains a wealth of reactions developed primarily in the steroid and carbohydrate fields and hence not generally familiar. Derivatives for characterization are included in their proper places according to the reactions by which they are formed.

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Scientific Book Register

DENNIS, WAYNE. (Ed.) *Readings in the history of psychology.* New York: Appleton-Century-Crofts, 19 Pp. xi + 587. $4.75.

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